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AN ANATOMICAL REASON FOR THE VARIOUS BEHAVIORS OF PARALYZED VOCAL CORDS

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The failure of all paralyzed vocal cords to behave in the same manner has caused much confusion. Many studies and investigations have been made in attempts to clarify and explain the vagaries of such behaviors.

During the last half year in the Department of Anatomy of the University of Washington School of Medicine, under the direction of Doctors Robert J. Johnson, Ralph L. Gregg, and Frederick L. Scheyer, medical and dental students have performed a number of dissections on cadavers with the objective, among others, of a careful study of the distribution of the recurrent laryngeal nerves. I now believe that we have, for the first time, a logical and rational answer to all the heretofore unexplained behaviors of paralyzed vocal cords.

One cannot ignore clinical observations in arriving at conclusions while considering motor nerve distribution and function. From the examination of several hundred paralyzed vocal cords both recent and old, roughly 150 of which were bilateral paralyses and 400 to 500 were unilateral paralyses, all have conformed to one of three patterns:

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1. Immediate adduction or midline position.
2. Immediate abduction or extreme opening of the paralyzed cord.
3. Intermediate position about halfway between abduction and adduction. This position is commonly called the cadaveric position.

Group 3, whether unilateral or bilateral paralysis, comprises about 90% of all vocal cord paralyses. That percentage also coincides with a rational anatomical explanation of what should occur. A fourth classification, that of interarytenoideus paralysis, has been described by some authors. The muscle is innervated by branches of both posterior rami of the recurrent nerves, paralysis of which without involving other muscles is a condition that I have not encountered.

A review of historical and anatomical background will, I think, be the best way to introduce our conclusions. Many studies of the nerve supply to the larynx have been made and quite a few excellent articles have been written on the subject (see the bibliography attached), most of which are designed to explain not only the motor nerve distribution to the larynx but also the behavior of the paralyzed cords. Berlin and Lahey report dissections showing fibres of the internal division of the superior laryngeal nerve entering the interarytenoideus muscle. Lemere believes these to be sensory fibres that pass through the muscle en route to the mucosa of the larynx. My observations lead me to concur with those of Lemere. That there may be exceptions to the usual pattern of motor neuron distributions to the larynx is easily conceivable. However, I have made no observations which lead me to believe there is any alteration in the ultimate distribution of the external divisions of the superior laryngeal nerves and the anterior and posterior rami of the recurrent nerves in human beings. Because of the complexity of communications of the cranial nerves which are of the peripheral or lower neuron type, confusion may occur as to the nature of paralytic lesions. Upper motor neuron lesions produce spastic paralyses. Lower neuron or peripheral nerve lesions produce, at first, flaccid paralysis followed by atrophy, fibrosis, and contracture of the affected muscles. The simplest form of peripheral nerve paralysis is observed in musculospiral or ulnar nerve paralysis, the only muscles affected being those supplied by the paralyzed nerve.

A similar pattern of distribution is not to be found in central or upper neuron lesions. For example, I have seen no paralysis of the larynx of upper neuron or central origin that did not also affect

some, if not all, the muscles of the pharynx, soft palate, and tongue. Frequently in such lesions muscles remote from the larynx and pharynx are also involved. The reason for such wide distribution of affected muscles in central lesions is because of the intimacy and close contact of neurons in the central tracts and nuclei of the brain. Considering the wide distribution and exercise of control which such intimately contacted neurons exercise, it is hardly to be expected that a pathological process could be so small and so accurately placed as to affect, for example, only the muscles of abduction or adduction of both vocal cords, leaving all contiguous neurons unaffected. It is still more unreasonable or inconceivable to conclude that such a process could permanently remain so localized. At least in my experience no such condition has been observed.

In this article we are primarily concerned with the origin and distribution of the motor filaments of the vagus nerves which supply the larynx, not with the branches which are distributed to the heart and abdominal viscera. Our conclusions are based on studies and investigations as well as information gained from the works and writings of anatomists. We are only concerned with the motor and sensory distributions to the larynx as well as an understanding of the motor functions of the normal and paralyzed larynx.

The vagus nerve is both motor and sensory. The entire motor and sensory nerve supply to the larynx is derived from two branches of the vagus, viz., the superior and recurrent laryngeal nerves. The motor neurons of the vagus are derived from the vagus roots proper and from the spinal accessory. The vagus nerves are variously described as being connected with the medulla by from eight to fifteen filaments which are the motor roots of the nerve proper and have their origin chiefly in the nucleus ambiguus and the dorsal motor nucleus in series with the glossopharyngeal nerve. The accessory neurons arise from the nucleus ambiguus only. The vagus fibres emerge from the medulla along the posterolateral groove between the olivary eminence and the inferior cerebellar peduncle. The spinal accessory fibres arise from the same groove below the tenth nerve as far down as the fifth cervical nerve and occasionally as low as the second dorsal root. After leaving the surface of the brain stem, the converging rootlets assemble to form a flattened trunk which passes upward through the foramen magnum beneath the flocculus of the cerebellum to the jugular foramen, through which it traverses along with the glossopharyngeal and the spinal accessory nerves.

At the upper margin of the jugular foramen it forms the jugular ganglion which communicates with the facial and spinal accessory

nerves, also the superior cervical sympathetic ganglion and the petrous ganglion of the glossopharyngeal nerve.

Below the jugular foramen it forms the ganglion nodosum which is 1 cm. to 1.5 cm. in length and 4 mm. in diameter. This ganglion communicates with the hypoglossal and spinal accessory nerves, the loop between the first and second cervical nerves, as well as the superior cervical sympathetic ganglion. Both ganglia are sensory in nature.

The superior laryngeal nerve, which is both motor and sensory, is given off the vagus at the ganglion nodosum. The internal branch of this nerve (Fig. 15) is purely sensory. The external branch of this nerve, which supplies the cricothyroideus muscle, is believed to be purely motor. The recurrent nerves on the two sides leave the descending trunks of the vagi at different levels and pursue somewhat different courses, although their ultimate distributions are the same on both sides. The right nerve is given off as the vagus crosses the anterior surface of the right subclavian artery around which it curves to pass upward, ultimately to be distributed to the larynx. As a rule it lies farther away from the trachea and oesophagus than the left. The right, more frequently than the left, lies external to the inferior thyroid artery. Like the left, it gives off branches to the trachea and oesophagus in its ascent.

The left recurrent nerve is given off the vagus in front of the arch of the aorta around which it curves to ascend to the larynx. In our experience and observations, the right nerve has divided into its anterior and posterior branches in the thyroid space more frequently than has the left. The left nerve, as before stated, more frequently passes mesial to the inferior thyroid artery and lies closer to the trachea and oesophagus.

Piersol has more nearly correctly described the anatomy and distribution of the recurrent nerves than any other anatomist whose works we have investigated. Oddly enough, he has given different versions of the distribution of the recurrent nerves in different pages of the same text. We quote him in part: "It is generally admitted that the bulbar or accessory portion of the eleventh nerve forms an intergral part of the motor division of the vagus, and, hence, should be included with the efferent fibres of the tenth. As to the ultimate distribution of these accessory fibres, and conversely of the vagus motor fibres proper, much discussion and many conflicting views have existed and, even at present, a consensus of opinion can scarcely be said to have been reached. After reviewing the evidence, both anatomical and experimental, Van Gehuchten concludes that the

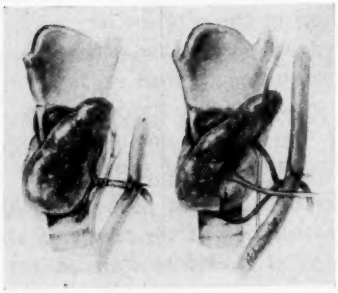
accessory fibres are distributed chiefly, if not indeed exclusively, to the larynx through the inferior laryngeal branch of the vagus, and are continued neither to the heart nor to the stomach."

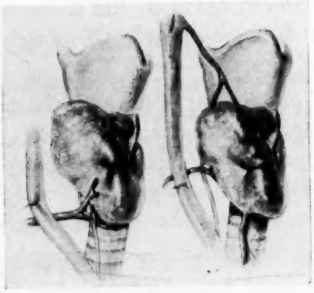
Piersol, in his "Human Anatomy", Vol. II, exactly described the anatomy and distribution of the recurrent nerve to the larynx as we understand it: "The inferior laryngeal, ascending by the side of the back of the trachea divides into two branches. The branch nearer the median line innervates the posterior cricoarytenoid and the arytenoideus muscles. Its fibres partly sensory, enter into communication with those of the superior laryngeal. The other branch of the inferior laryngeal goes to the other intrinsic muscles of the larynx." In other words, one branch of the recurrent nerve supplies the abductors, the other branch, the adductors of the vocal cords. The significance of that quoted statement seems to have been lost by both laryngologists and thyroid surgeons.

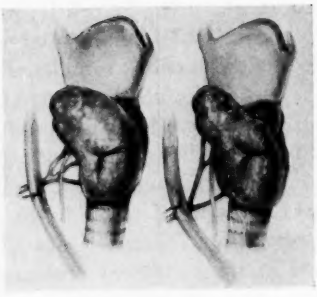
The quoted description from Piersol coincides accurately with the anatomy and distribution of the recurrent nerves as we worked it out. Piersol, however, failed to mention the division into two branches of the recurrent nerves within the thyroid space. Nordland published an excellent illustration (Fig. 12) showing the distribution of the recurrent nerve to the abductors and adductors of the cords, but failed to mention it in the descriptive material of the article.

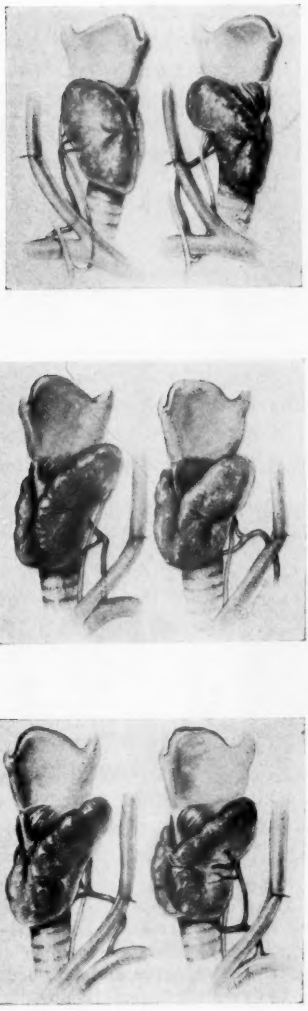
From a clinical standpoint, I have seen nothing to indicate any variation from the pattern that the abductor, adductor, and constrictor muscles of the larynx are supplied and controlled by the recurrent nerves, and the tensors of the vocal cords (cricothyroid muscles) by the external branches of the superior laryngeal nerves.

In consideration of vocal cord paralysis and speech difficulties it is well to bear in mind that they are not one and the same condition. Vocalization or sound production in man is a pure physiological product of the vocal cords. Speech is the conversion of that sound into words. Vocalization or sound production is produced in the larynx and is aided by the extrinsic muscles of the larynx. Speech is the product of the structures of the pharynx, soft palate, nasopharynx, tongue, teeth and lips. Sound is produced by the passage of a current of air between the vocal cords. It varies in quality because of the rate of flow of the current, taughtness, length of the vocal bands, etc. Air is propelled through the vocal bands by the extrinsic muscles of respiration. Some, if not all, of the muscles of the neck are involved in the combined processes of sound production and phonation.

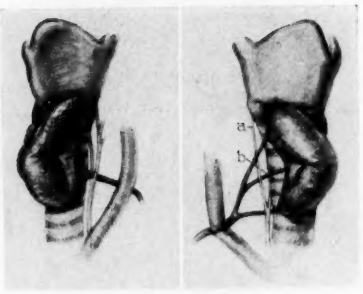


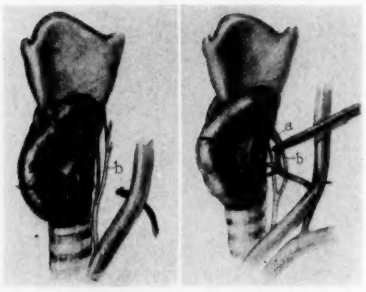






Figs. 1 to 7.—Illustrations made from dissections before it was realized that the recurrent nerve frequently divided in the thyroid space or injury zone.





Figs. 8 to 11—These illustrations were made from the second group of dissections and all show the nerve dividing in the thyroid space. Fig. 11 shows how it is possible to injure one division of the recurrent nerve without injuring the other. This type of injury accounts for the different positions which the paralyzed cords may occupy.

An Englishman and a Chinaman produce sound in the same manner. It may be of the same tone and quality; one converts the sound into English and the other into Chinese. The presence of vocal cords, or even a larynx, is not an absolutely necessary requirement to speech production as evidenced by laryngectomized patients who have been trained to talk by one of three methods, either by swallowing air and regurgitating it in a manner capable of producing sound, by vibration of mucosal folds of the hypopharynx at the upper end of the oesophagus, or by means of an artificial sound producing mechanism such as the artificial larynx. By means of such devices sound is directed into the pharynx where it is converted into words. Such voices, while monotonous and somewhat guttural, are far more satisfactory than no voice at all.

It is therefore to be remembered that vocalization and speech are conducted by two different mechanisms and controlled by two different sets of muscles and nerves. There is some overlapping of functions of the muscles and nerves but the two processes are well coordinated and synchronized.

As stated earlier, the cranial nerves which control and direct the muscles of sound production are the vagus and the spinal accessory. The cranial nerves which control and direct the mechanism of speech include the ninth, tenth, eleventh, and twelfth nerves. However, the speech mechanisms are controlled and directed by different divisions and branches of these nerves. In addition the seventh, or facial nerve, plays an important role in speech. The fifth trifacial nerve which controls the muscles of mastication also takes part in phonation. The eighth auditory nerve, one of the nerves of special sense, while taking no part in the production of speech, plays an important role in the developmental training necessary for normal speech. A child born deaf may, by training, acquire a capacity to speak, but never normally. Speech is a trained imitational faculty which never attains normalcy in the absence of an auditory nerve. There are a few outstanding examples of persons who by intelligence and persistence have gone far in overcoming this handicap, of whom Helen Keller is a notable example.

This description of the wide sources of origin and distribution of the motor neurons to the organs of voice and speech is given partly to direct attention to the improbability of any but a gross pathological process of central origin being responsible for total paralysis of either group of muscles. A lesion of central origin, large enough to cause total loss of function of either group of muscles because of the widespread intercommunication of the neu-

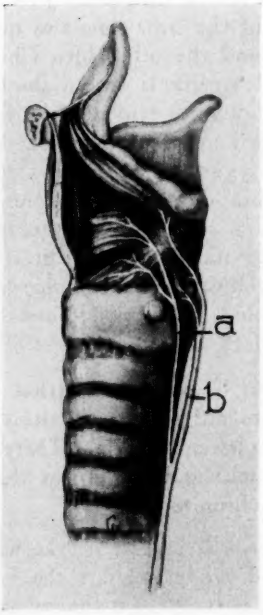


Fig. 12—(Modification from Nordlund) This illustration accurately shows the nerve distribution as we have found it. The only alteration from the original is that this one shows the nerve dividing into anterior and posterior branches within the thyroid space.

rons of the cranial nerves would, most certainly, affect some, if not all, muscles of both the larynx, pharynx and tongue. All the clinical observations I have made sustain this conclusion.

Peripheral nerve lesions which affect the muscles of the larynx alone are simpler and easier to understand. The total motor distribution to the laryngeal muscles is through two divisions of the vagus. The superior laryngeal nerves, through their external branches, supply the cricothyroideus muscles. The recurrent nerve through their anterior and posterior rami supply all other muscles of the larynx. A single lesion, in order to produce total paralysis of one half of the larynx, must be at, or above, the ganglion nodosum on the affected side, as the superior laryngeal nerves are given off the vagi at the ganglia nodosa. The recurrent nerves are given off the vagi at lower levels on the respective sides.

A discussion of all the lesions which cause lower neuron paralyses of the larynx is omitted from this article. It will be made on another occasion. The primary purpose here is to explain how adduction, abduction, and intermediate (cadaveric) position vocal cord paralyses occur as the result of injuries to the trunk of the recurrent nerve or to the anterior and posterior rami of the nerve.

Regardless of the sources from which the vagus derives its neurons, the fact remains that its ultimate distribution is largely the same in practically all individuals and that in the absence of pathology the functions of the larynx are conducted in the same manner.

In none of the dissections we have made have we any reason to believe that the interarytenoideus and musculi aryepiglottici derive their motor supply from any source other than the recurrent nerve. We have not only been able to trace the recurrent nerves to these muscles, but to observe that, in every instance where the common trunk of the recurrent nerve is injured, there existed paralysis of the abductors and adductors of the vocal cords as well as hemiparalysis of the interarytenoideus and musculus aryepiglotticus of the same side. The cricothyroid muscles are not affected by recurrent nerve paralyses.

It is the conclusion of many anatomists, with whom we are in accord, that the recurrent nerves carry neurons to both abductor and adductor muscles of the vocal cords. We, as well as others, have been able to demonstrate that the recurrent nerve divides into two main branches, one of which is distributed to the cricoarytenoideus posticus, (abductor muscle), to the interarytenoideus muscle and the musculus aryepiglotticus. The other, or anterior ramus, supplies the thyroarytenoideus, the epiglotticus and the cricoarytenoideus lateralis. The cricothyroideus muscles, tensors of the vocal cords, supplied by the external division of the superior laryngeal nerves, have much to do with the range of voice, not with adduction or abduction of the cords.

In my experience lesions of central origin causing laryngeal paralysis present an entirely different clinical picture and symptomatology from those occurring in the vagus or its branches. I have seen no laryngeal paralysis resulting from lesions in the bulb or above it in the nuclei, cortex or any part of the brain that was not associated with paralytic disturbances of muscles of the pharynx and tongue, and, frequently, with motor disturbances remote from the larynx. The majority of such palsies or paralyses that have come under my observation have resulted from progressive bulbar par-

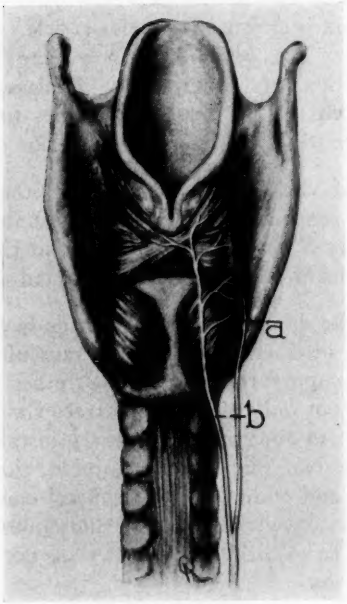


Fig. 13—Showing the recurrent nerve dividing in the thyroid space with the anterior ramus extending to the pyriform fossa and the posterior division in a more mesial position.

alysis or cerebral hemorrhage. I know of no surgical procedure that could be of any benefit to patients suffering from such lesions.

Since the accompanying illustrations (Figs. 1 to 7 inclusive) were made, additional dissections have been completed. Photographs of six recurrent nerves illustrating the point to be made were taken, only one of which was successful; it is included (Fig. 16).

From our studies the following anatomical findings were confirmed and conclusions made which we believe to be the first correct and logical explanation of the behavior of all paralyzed vocal cords of the lower motor neuron group.

As earlier stated, the recurrent nerve divides into two trunks, one to supply the abductor muscles, the other to the adductors. The usual point of division into the respective trunks is at, or near, the lower border of the cricoid cartilage on its posterior surface behind

and mesial to the inferior cornu of the thyroid cartilage. Although it had been previously observed by us and others that the recurrent nerve sometimes divided at a lower level, no significance up to now had been attributed to this point of division, yet it offers the only rational explanation of all lower motor neuron vocal cord paralyses. In 16 cadavers dissected, the division of the nerve into two trunks took place in what we shall designate as the nerve injury zone. By this is meant that portion of the thyroid space in which the nerve, by its location, is subject to injury during thyroid surgery. The upper limits of this zone are easily defined as the nerve passes behind the trachea and larynx just below the inferior cornu of the thyroid cartilage and is no longer within reasonable danger of injury. The lower border of the injury zone is less easily defined as it depends on the size of the gland and its downward extension or projection.

Of 16 dissections made involving 32 nerves, in eight instances the nerve on one side divided into two main trunks within the injury zone so that it would easily be possible to injure one trunk without doing damage to the other. In two of the eight nerves so divided, the division occurred below the inferior thyroid artery, and, in one of these, one trunk passed outside the artery and the other inside with a full ¼ inch separation at that point (Fig. 16). In the other two instances, branches of the inferior thyroid artery passed between the trunks at a higher level. It is thus readily understood how one trunk can be injured and the other escape. It requires only a simple formula to explain the resulting paralyses. If the division supplying the abductors be traumatized the cord will be paralyzed in adduction and vice versa. If both trunks are paralyzed, as is the usual case in the predominant anatomical distribution, both adductors and abductors are paralyzed leaving the cord in the intermediate position or that of flaccid paralysis, commonly called the cadaveric position. These conclusions conform in every way to our clinical and anatomical observations.

The paralyzed cord in the intermediate (cadaveric) position usually, if not always, follows a definite pattern. The pattern is that of all motor nerve paralyses. First, there is flaccid paralysis followed by muscular atrophy, fibrosis, and contracture. As a part of these changes the paralyzed cord in the intermediate position gradually shifts to a contracted state in the midline position. It is my opinion that the true cadaveric position is only observed in recent recurrent trunk nerve paralysis and in the cadaver, or in rare instances in which the recurrent nerve and the external division of the superior nerve on the same side are simultaneously paralyzed.

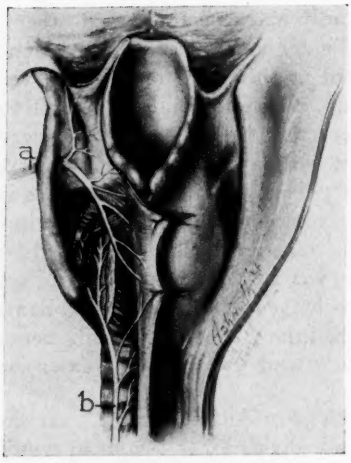


Fig. 14—(Modification from Tolt) This illustrates the same distribution as Fig. 15. However, there is no direct connection of the internal division of the superior nerve with the posterior division of the inferior nerve.

When the abductor and adductor muscles are paralyzed there can be no muscle tone affecting either. However, if the cricothyroid remains unparalyzed it continues to function, and during each vocal effort tends to adduct the vocal cords to a minor degree. These repeated efforts with no opposing abductor function, together with gradual contractures of the vocal cords and bands, tend to aid in the shifting of the cords from the intermediate to the midline position. In all the cases of bilateral vocal cord paralysis I have examined, it has been possible to observe with a laryngeal mirror that the patients are able to produce further adduction of the cords when asked to phonate E. This adduction is undoubtedly due to contracture of the cricothyroid muscles. I have never seen a paralyzed cord which immediately assumed the midline position shift outward, nor have I observed a single instance of a cord paralyzed in extreme abduction shift toward the midline. The explanation is that when the cords are paralyzed in the midline position the abductors only are paralyzed; when in extreme abduction the adductors are paralyzed.

A sufficient number of dissections have been made to demonstrate that the point of bifurcation of the recurrent nerve into two

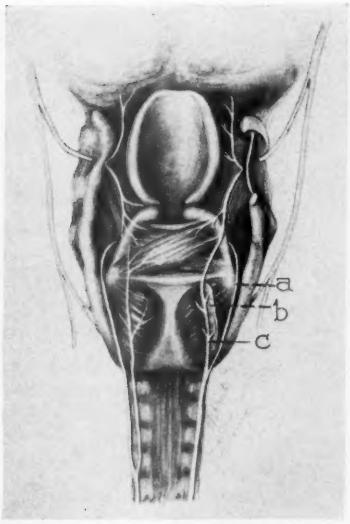


Fig. 15—(Modification from Nordlund) This is an illustration of both the superior and inferior laryngeal nerves showing variations that occur. On the right side the recurrent nerve is seen to connect with the internal division of the superior laryngeal nerve. On the left side no such connection is present. On the right side the recurrent nerve is seen to divide at the lower border of the cricoid cartilage. On the left side the nerves divide in the thyroid space.

main branches does not, in any way, affect the ultimate distribution of the nerve filaments to the adductor and abductor muscles of the larynx. The dissections which have been carried out have shown, in every instance, that there were two branches which supplied the adductors and abductors. There are other filaments given off at the lower border of the cricoid cartilage which seem to pass underneath it and are distributed on the inside of the larynx. We have not attempted to follow these filaments to their definitive locations. Some anatomists describe the recurrent nerve as entering the larynx at the lower border of the cricoid cartilage, posterior to the inferior cornu of the thyroid cartilage. However, our conception of the distribution of the nerve is that only a minor portion of it enters the larynx at this point and that the two main branches are, as above described, on the posterior surface of the larynx. The posterior division divides and redivides into filaments which spread out and enter the cricoarytenoideus posticus. A branch of the posterior division passes

Fig. 16—This is an actual photograph of a dissection showing the recurrent nerve dividing into the anterior and posterior divisions, one passing on the inside of the inferior thyroid artery and the other on the outside.

above the cricoarytenoideus posticus to enter the interarytenoideus, where its filaments are distributed and also supply the musculi aryepiglottici of the respective sides, so that this branch is not only distributed to the abductor muscles of the larynx but also gives motor innervation to the constrictor mechanism of the glottis. The other, or anterior division, supplies the adductors.

It is interesting to note that the accompanying illustrations, from Figs. 1 to 7, were made before we appreciated the fact that the recurrent nerve divides into anterior and posterior rami or that these rami supplied respectively the adductors and abductors of the vocal cords. Of the 11 illustrations made from actual dissections, four, or slightly more than 30%, show the nerve dividing into two branches in the thyroid space. Of the 32 nerves dissected in the next group of cadavers, during the course of which studies we arrived at the herein described conclusions, it is interesting to

Fig. 17—This illustrates the positions which the nerve may occupy in relation to the vessels as the result of an adenomatous goitre on the posterior surface of the left lobe.

note that in eight instances the nerve divided into two branches in almost the same percentage.

It is my conclusion that all motor paralyses limited strictly to the larynx are of peripheral or lower neuron type, that the positions assumed by the paralyzed cords are entirely explainable on the basis of the muscles involved and that, regardless of the etiological factor producing the paralysis, all are rationally explained by the aforementioned anatomical findings.

The accompanying illustrations, numbered from 1 to 7, are the artist's conceptions of the actual dissection and illustrate the anatomical findings of recurrent nerves dividing in the injury zone or thyroid space. Difficulty was encountered in successfully photographing the dissections. Only one photograph was entirely satisfactory (Fig. 16). It shows the recurrent nerve dividing into two branches below the inferior thyroid artery with one branch passing on either side of the artery. Illustrations numbered 3A, 4A, 8, and 11B show the divisions of the nerve as we have described them.

The treatment of bilateral vocal cord paralysis has been previously described as well as the most recent technique. Others have modified this operation and a description of the modification is also available. At a meeting of the Pacific Coast Oto-Ophthalmological Society on May 6th, 1947, Dr. Lewis Francis Morrison[16] described for the first time a successful operation for unilateral vocal cord par-

alysis in extreme abduction with aphonia, a description of which was recently published.

Dr. Ralph Gregg and I have recently been able to demonstrate experimentally on the dog that all the contentions herein made are correct. In the dog we have been able to produce adduction, abduction, as well as both adductor and abductor paralysis, by simple division of the nerve rami to the respective muscles or by division of the recurrent nerve trunk. The same conditions prevail bilaterally when both nerves are so treated.

Lemere, has thoroughly covered the distribution of the superior laryngeal nerve. His conclusions are that the internal divisions are purely sensory and that the external divisions are purely motor and supply only the cricothyroid muscles. We have confirmed Lemere's findings not only with anatomical dissections in the human larynx but also in the dog's larynx. Faradic stimulation of the internal division of the superior laryngeal nerves causes no contractures of any muscles of the larynx. Stimulation of the external division of the superior laryngeal nerve uniformly causes contraction of only the cricothyroid muscle supplied by the stimulated branch. It is, therefore, perfectly clear that the internal division of the superior laryngeal nerve is purely sensory and that the external division is purely motor and supplies only one muscle, all other muscles of the larynx being supplied by the recurrent nerve. We have found no variation from this pattern of nerve supply to the larynx. Furthermore, the clinical observations of the paralyzed larynx conform in every way to the above described nerve supply to the larynx.

The most common type of vocal cord paralysis observed is due to injury to the trunk of the recurrent nerve, causing paralysis of both abductors and adductors to the cord. As a result of atrophy, fibrosis, and contracture aided by the slight adductor effect of the cricothyroid muscles, the paralyzed cord shifts from an intermediate position to a midline position in the majority of instances.

There still exists in my mind some confusion as to the motor distribution and control of the sphincter mechanism of the larynx. Faradic stimulation of the ramus to the interarytenoideus causes complete contraction of the sphincter mechanism of the glottis on both sides. It may be because the interarytenoideus, even though supplied by both recurrent nerves, reacts to stimulation throughout its entire length or to faradic stimulation from either side. Stimulation of the rami to the adductors and abductors causes only unilateral contraction.

In unilateral recurrent trunk nerve paralysis of the human larynx the interarytenoideus is incapable of effecting the sphincter mechanism on the paralyzed side or of adducting the arytenoid cartilage or vocal cord on the same side.

We have not conducted experiments on animals like the horse which has a double interarytenoideus muscle with a median tendinous raphe connecting the two muscles. Further studies and experiments will be required in order to completely understand the operations of the sphincter mechanism of the larynx.

The practical application of this work lies not so much in the field of treatment of such paralyses, although that is highly important, as in developing a technique for the prevention or avoidance of such paralyses. The vast majority of these paralyses are the result of nerve injuries during goitre operations. Figure 11 illustrates how it is easily possible to injure the anterior ramus of the recurrent nerve, thereby affecting paralysis of the adductors of the cords. The same concept can be applied to injuries to the posterior ramus with the resulting paralysis of the abductors. By far the most common type of recurrent nerve injury is to the trunk of the nerve before its division into anterior and posterior rami, thus paralyzing adductors, abductors, and constrictors of the larynx. A program for the prevention of such injuries, as well as the repair, has been developed and will be published under another title.

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Note: Sir Felix Semon in an article published in Archives of Laryngology, 1881, entitled "Clinical Remarks", describes all the nerve supply to the larynx exactly as we have described it, except he states that the aryepiglottic muscles are supplied by the anterior ramus of the recurrent nerve. Piersol also ascribes the nerve supply for this pair of muscles to the same source. It is possible that we are in error in attributing the nerve supply to the posterior ramus. However, there is no doubt that this pair of muscles operates as a part of the constrictor or defensive mechanism of the larynx. We believe that this pair of muscles is a continuation of the interarytenoideus muscle and is innervated respectively by branches of both posterior rami of the recurrent nerves. In considering the fact that the anterior ramus of each side supplies the adductors and that the adductors are, in certain circumstances, a part of the constrictor mechanism of the larynx, it may be that these muscles are supplied by branches of the anterior rami.

It is not intended in this article to discuss Semon's Law with which I am in disagreement. The only law that I accept in regard to nerve paralyses is the irrefutable law that upper motor neuron paralyses are spastic and that the lower motor neuron paralyses are flaccid followed by atrophy, fibrosis, and contractures of the affected muscles. A discussion of Semon's Law will be given at another time and place.

LXXIX

THE "REVERSE KING OPERATION"

A SURGICAL PROCEDURE FOR RESTORATION OF PHONATION IN CASES OF APHONIA DUE TO UNILATERAL VOCAL CORD PARALYSIS

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The value of the King operation to restore an adequate airway and retain a useful voice in cases of bilateral abductor paralysis has been established. Not being satisfied with just one contribution in this field, a letter from Dr. Brien T. King dated February 23, 1947, reads in part:

"You will be interested to know that I have developed a new operation for unilateral cord paralysis with loss of voice. I have only done it once and it turned out quite successfully. You, no doubt, have occasionally seen a patient with unilateral cord paralysis in which the vocal cord came to rest in extreme abduction in which the patient was unable to develop the compensation on the part of the unparalyzed cord with consequent loss of voice. I decided after seeing several such cases that it might be possible to disarticulate the arytenoid cartilage and move it to midline on the crest or the upper border of the cricoid cartilage. In doing this operation it is necessary to thoroughly divide the fibers of the cricoarytenoideus lateralis muscle. That produces sufficient mobility of the arytenoid cartilage to allow it to be displaced to the midline where it is fixed on the upper border of the cricoid cartilage. As I said I have operated one such case with marked improvement in the voice and no disturbance in the airway. As you will readily understand the old problem of the paralyzed vocal cord resolves itself into a rather simple one of fixing the paralyzed cord into the position of best functional use. Will you please think this over and write me your thoughts on this new problem?"

Frankly, I was impressed with the idea but not greatly interested. This lack of interest was explainable by the fact that patients with this condition are not too numerous. I had not seen such a larynx for many months and had no immediate prospects for attempting the procedure. The anatomical and mechanical details were worked out on two fresh cadavers and the whole subject filed away under the heading of "if and when."

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Presented before the Pacific Coast Oto-Ophthalmological Society Meeting, Seattle, Washington, May 6, 1947.

Nearly a year later a suitable candidate was seen at the Veterans' Hospital at Fort Miley in San Francisco, California. The patient was almost aphonic. This condition was crippling for an individual who had to depend on his voice for a livelihood. Examination of the larynx showed the left vocal cord to be fixed in extreme abduction. The right cord was not able to accomplish the necessary excursion for adequate approximation, and such sounds as were produced on attempted phonation were accompanied by marked wasting of the air. Sounds produced during conversation were essentially those from the false cords, the result of great effort, wholly lacking in volume, quality and timbre, and usable for only short periods of time.

A request to Dr. King for further details on the new operation brought forth the following reply:

" . . . you remember we previously had correspondence about exactly the same sort of patient which you described in your recent letter. I have seen several such instances and apparently no one had ever thought of trying to do anything for them.

"You may be interested to know that the one patient on whom I have operated for this difficulty did not secure a very good result. There was some improvement in the voice but I did not succeed in getting the paralyzed cord in a midline position and after examining the patient I came to the conclusion that I had not sufficiently displaced the arytenoid cartilage and the vocal band. I now believe it to be desirable to move the arytenoid cartilage beyond the midline and fix it on the upper and posterior rim of the cricoid cartilage. I did not have much difficulty in passing a suture through the cricoid cartilage and tying it around the arytenoid but simply think that I failed to displace it far enough to move the vocal band into a midline position. In other words, I now think it wise to move the arytenoid cartilage a little beyond the midline. In order to do that it is going to be necessary to thoroughly divide the fibers of the crico-arytenoideus lateralis muscle. That is not difficult to do, simply take a knife and insert it just outside the arytenoid cartilage and thoroughly cut away the paralyzed fibers of the crico-arytenoideus lateralis. It is also important to divide the fibers of the capsule of the crico-arytenoid joint. I think that one should also cut away about half of the interarytenoideus muscle and reattach the divided end of the muscle to the mesial border of the arytenoid cartilage by slinging a suture around the midportion of the arytenoid cartilage and passing it through the divided end of the interarytenoideus muscle.

"In principle the operation should be effective and as long as the unparalyzed cord is not interfered with, it should produce an adequate voice and not disturb the airway."

With this information and a review of the mechanical and anatomical problems using fresh cadaver material, the operation was performed on February 23, 1948.

REPORT OF A CASE

The patient entered the hospital on February 13, 1948, with the complaint of progressive hoarseness for about four years.

This 55-year-old white male gives a history of sudden onset of aphonia some four years ago. At this time, he states, he was quite nervous and in a general run-down condition, both physically and mentally, because of business conditions. After some three months this aphonia cleared up considerably and he was able to talk, yet had considerable huskiness of voice. This has remained persistent and of about the same severity. There has been no pain, cough, nor hemoptysis. He gives no history of injury to his throat or neck. He has experienced moderate dyspnea on physical exertion for the past four years. Colds and sore throat have been very infrequent. The patient gives a history of having had drainage from the left ear in early childhood. He states he has had slight impairment of hearing of the left ear since then. His tonsils were removed at the age of 40 years.

The examination shows the external canals to be clean. Both drumheads are intact, yet present a rather dull and thickened appearance. The left ear shows a fairly prominent healed perforation in the posterior inferior quadrant. The patient hears low conversation voice, 20/20 bilaterally. Tuning fork tests—512 and 1024: The Rinne test is positive bilaterally; the Weber lateralizes to the right; the Schwabach is slightly diminished in the left ear. Audiogram shows mild uniform lowering of the entire tone range for air conduction for the right ear. The bone conduction curves are within normal limits.

The septum is moderately thickened, irregular and wavy. There is considerable crust formation over the anterior portion of the left side of the nasal septum. The mucosa presents mild hypertrophic changes. There is no evidence of secondary sinusitis. The nasopharynx is clean; the adenoids are small and atrophic. The eustachian tubes are patent. There is a small mass of lymphoid tissue in each inferior pole of the tonsillar fossa. The lingual tonsil is small and atrophic.

Examination of the larynx reveals what appears to be a paralysis, or at least an immobility, of the left true vocal cord. It presents a flattened appearance and there is a thickening and an outward flaring of the left arytenoid. As a result of this deformity the right arytenoid appears to impinge upon the left true vocal cord, in front of the left arytenoid, on phonation. There was no reaction from either the faradic or galvanic currents on stimulation of the left vocal cord. In laminographic studies the crico-arytenoid articulation was clearly visualized. Although there was no difference between the appearances of the left and right articulations, a flat,

slightly spindleshaped soft tissue shadow was demonstrated on the left side extending from the region of the ventricle down to the lower end of the cricoid cartilage. This may well be due to inflammatory swelling of the soft tissues surrounding the crico-arytenoid articulation. Maximum swelling was seen just above (medially) the articulation itself. On direct laryngoscopy the left crico-arytenoid joint and the left vocal cord were seen to be drawn laterally. On phonation there was no movement of either the crico-arytenoid joint or the vocal ligament on the left. On probing it was found that there was no movement in the crico-arytenoid joint. There was no sign of inflammation in the area. Bronchoscopy was done as well and no abnormalities were noted.

Laboratory examinations showed the serological tests for syphilis to be negative. Blood counts were within normal limits. Urinalysis revealed a persistent trace of albumen. Microscopic examination showed no cells.

Examination of the chest by x-ray shows only small parenchymal calcifications. The cervical spine shows mild degenerative fringing in the mid-cervical region. The sinus x-rays appear clear.

The patient was discharged from this hospital on March 3, 1948, with the following diagnosis: Laennec's cirrhosis; ankylosis of the crico-arytenoid articulation; hypertensive cardiovascular disease; sclerosis of the aortic valve—(patient able to carry on ordinary physical activity without discomfort); slight general arteriosclerosis; congenital ptosis of eyelids; congenital clubbed finger; chronic alcoholism; osteoarthritis of the cervical spine; congenital esophageal hiatus.

A laryngoscopy was done and a diagnosis of ankylosis of the left crico-arytenoid joint was made on original hospital entry. The second hospital entry was on February 13, 1948. The patient was immediately started on high-vitamin, high-caloric diet and a week later a tracheotomy was performed without difficulty. An uneventful convalescence followed. Approximately ten days later, the patient was taken to the operating room where the crico-arytenoid joint on the left side was freed and brought toward the midline (reverse King procedure). He was able to take a soft diet immediately following the operation and continued to maintain nutrition by mouth. Approximately three days following surgery, a superficial infection in the region of the incision developed and was treated with heat. The patient had been receiving penicillin both before and after the operation. On March 1, 1948, a small incision was made in the region of the operative scar and a small amount of thin, watery pus

was obtained. On continuation of heat therapy, the swelling and the redness regressed almost to normal. On examination of the larynx an adequate airway was seen. The left vocal cord was directly in the midline and, apart from some moderate inflammatory or edematous-appearing swelling in the region of the body of the left arytenoid, there was no sign of a postoperative complication. There has been a concomitant, 3 cm. enlargement in the transverse diameter of the heart.

Pathological specimens were taken of the crico-arytenoid joint and the following report was obtained, "A few small patches of bony tissue with adherent fibrous tissue."

Diagnosis: Ankylosis of the left crico-arytenoid articulation.

Operations: Manipulation of the left crico-arytenoid joint. Tracheotomy. Reverse King operation.

TECHNIQUE

Anesthesia: Intravenous sodium pentothal plus nitrous oxide and oxygen were given intratracheally through the tracheotomy opening.

Procedure: A modified Kocher incision was made at the level of the midportion of the thyroid cartilage, extending from the lateral border of the sternocleidomastoid muscle to a point slightly past the midline. The usual landmarks were visualized and exposed. There were no anatomical anomalies. The anatomical dissection was uncomplicated by cicatricial tissue, as is usually the case with post-thyroidectomy bilateral abductor paralysis cases. This patient's neck had not been subjected to previous surgery other than the tracheotomy which was developed through a curved horizontal incision just above the suprasternal notch. Following exposure of the crico-arytenoid articulation by cutting through the crico-arytenoideus posticus fibers, the articular surfaces of the joint were exposed by completely severing the fibers of the ligaments comprising the capsule. The articular surfaces were not as smooth and glistening as is usually the case. Several small fibrous bands attaching the articular surface of the arytenoid cartilage to that of the cricoid cartilage were demonstrated. These fibrous bands can readily account for the fixation of the arytenoid as found on direct laryngoscopy. During that examination attempts to mobilize the left arytenoid were unsuccessful. All of the fibers of the crico-arytenoideus posticus were cut as were the major fibers of the crico-arytenoideus lateralis (Fig. 2-B). The fibers of the arytenoideus were not severed and reat-

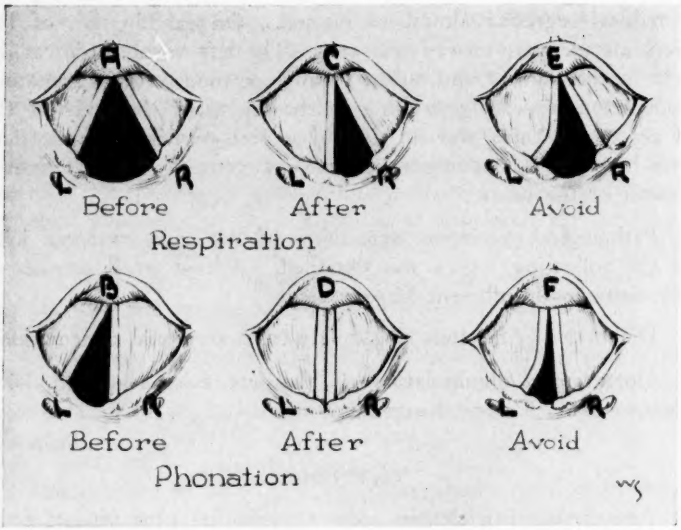

Fig. 1.—*A.* Appearance of vocal cords on inspiration before operation. *B.* Appearance of vocal cords on phonation before operation. *C.* Appearance of vocal cords on inspiration after operation. *D.* Appearance of vocal cords on phonation after operation. *E* and *F.* Appearances that would have denoted medial rotation of the arytenoid on the long axis. This did not occur in this case and should be avoided in all cases.

tached as suggested by King. A thin shaving of the articular surface of the arytenoid cartilage was removed for two reasons:

1. To obtain a specimen for histopathological examination to ascertain the presence or absence of arthritic changes.

2. To destroy the synovial surface so that it would more readily attach in a new position to be made at or near the midline on the upper surface of the cricoid cartilage.

The upper posterior rim of the cricoid cartilage—that portion between the facets for the articulation of the arytenoids—is higher than the articular regions. If the arytenoid cartilage is simply moved to the midline and placed on top of this ridge, the vocal cord will be from 1 mm. to 2 mm. higher than its normal position in relation to the opposite cord. In order to obviate this factor, approximately 1.5 mm. was cut away from the upper surface of the cricoid cartilage. The area removed extended from the mesial border of the

articular surface to the midline. In addition to permitting the cord to remain at a proper level without rotation in any plane, this local insult engenders a more rapid tissue response and greater likelihood of ultimate sound fixation of the arytenoid in the midline position.

This all reads as though the removal of the triangular shaped piece of cartilage (Fig. 3) were the result of long hours of deliberation and a superior ability to anticipate all the mechanical factors associated with repositioning the arytenoid in the midline. Such was not the case in spite of the hours devoted to the problem. An endeavor to obtain a satisfactory and representative piece of the cricoid cartilage showing the articular surface of the crico-arytenoid joint and sufficient surrounding cartilage to permit identification of the area was the direct cause. The exposure of the field by the lateral approach offers a simple and direct way of obtaining this specimen by selecting the upper mesial portion of the facet and cutting toward the midline. Mechanically it is the more easily controlled maneuver and permits one to see what is being cut as the blade progresses toward the midline. The fact that a little more tissue was removed than had been anticipated is beside the point. As soon as the arytenoid was placed on the cut surface it was realized that the position was ideal. The defect caused by the endeavor to obtain an adequate biopsy specimen had offered the solution to a problem I had not been able to work out on the fresh cadaver material. On hindsight it is so simple and logical. This removal of a small segment of the upper surface of the cricoid cartilage should be considered as an integral part of the technique. It should be employed routinely except in such instances as probably exist wherein the level of the articulation is equal to that of the ridge between the articular areas. Thus far I have not actually encountered such a condition nor have I seen it described in any of the texts. However this does not mean that such a rarity cannot exist.

The use of a medium sized, sharp-pointed hook embedded in the arytenoid cartilage is a great help in stabilizing and manipulating the cartilage into advantageous positions for visibility and accessibility. Both these factors are of prime importance for distinguishing the muscle attachments and making certain that the ligamentous capsule attachments have been severed. Prior to exposing the articulation surfaces the entire surgical field should be free of any evidences of bleeding. Oozing surfaces will produce sufficient blood to be both distracting and seriously impair visibility. Two long handled Bard-Parker knives, one with a No. 15 and the other with a No. 11 blade, are most useful for the sharp dissection in and about this area.

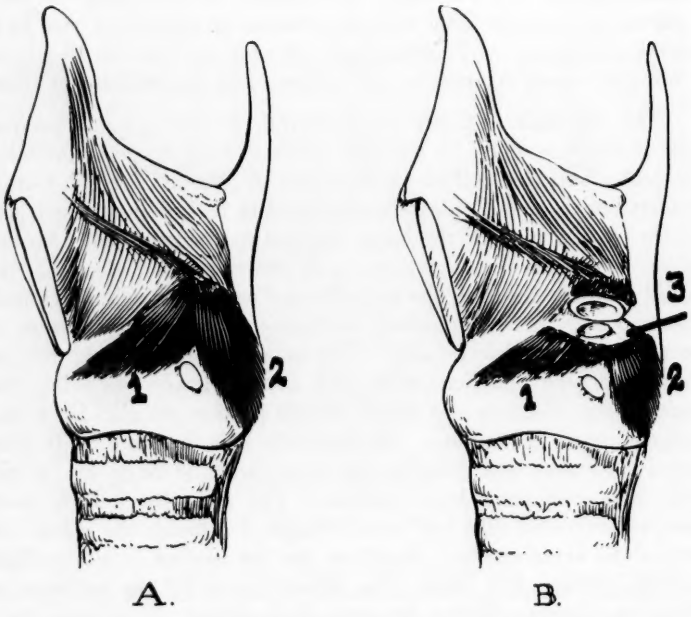

Fig. 2.—For the purpose of demonstration, the illustrations show the larynx with the left side of the thyroid cartilage removed. *A.* General anatomy showing: 1. Crico-arytenoideus lateralis and 2. Crico-arytenoideus posterior muscles. *B.* Showing complete disarticulation of the left arytenoid. The articular surfaces are emphasized. 3. It is of interest to note that the posterior superior border of the cricoid cartilage is at a higher level than the articular surface.

The use of a fine atraumatic needle and tantalum wire was tried. The first needle bent into a useless shape and the second needle broke. The recovery of the free segment delayed the procedure for about ten minutes. The idea is still a good one but will be reserved for use through a cricoid cartilage that contains little if any calcification.

The atraumatic P 271 No. 1 chromic catgut suture routinely used in the King operation was not available due to my lack of foresight. An ordinary medium sized full curved cutting edge Martin needle loaded with No. 40 black cotton was used successfully. The needle was started through the soft tissues and perichondrium of the upper portion of the posterior surface of the body of the arytenoid.

The exit was at the articular surface edge. The needle point then entered the cut surface of the cricoid cartilage and emerged on the posterior surface about 2.5 mm. below the point of entry. The cotton suture was tied so that the knot presented posteriorly (Fig. 3). The wound was closed in layers in the usual manner. Direct laryngoscopy immediately following the conclusion of the surgery and while the patient was still under anaesthesia showed the absence of any free blood in the hypopharynx or larynx, moderate ecchymosis of the soft tissues of the left arytenoid, and the left cord taut and in the midline (Fig. 1). The space relationships of the arytenoid were satisfactory in all respects. The appearance of the left side of the larynx simulated that of a normal larynx during phonation.

COMMENT

I take this opportunity to direct praise and credit due, yet too often not accorded, a pioneer in this field. The idea and technical details were originated by Dr. Brien T. King. The excerpts from his letters presented in the opening paragraph dates and establishes this fact.

The crippling results of aphonia or even marked diminution in voice function need no elaboration. In certain easily diagnosed cases this loss of impairment of function is due to fixation of one vocal cord in a degree of abduction sufficient to defeat any sustained attempts of approximation by the opposite cord. The condition also interferes with sound production by substituting the vocal bands. The procedure outlined is, to the best of my present knowledge, the first report of a function restoring surgical approach. The affected arytenoid and the attached important structures are repositioned in the midline and permanently fixed in that position. This allows accurate apposition by the uninvolved vocal cord for the production of sound and leaves an airway that is adequate in all respects. The results obtained in this patient justified all of the theoretical claims. Examination two months after operation shows the voice is of good volume, flexible as to tone range and shows no evidence of fatigue after a day of more than average use in ordinary conversation and use over the telephone. The patient is now completely rehabilitated. His present occupation demands spending a minimum of three hours per day in telephone conversations and the rest of the eight hours is spent in interviewing personnel and answering the ever present questions associated with a public relations position. He is truly pleased with his voice and volunteers the information that it is a pleasure to talk when it doesn't tire one. There is a slight quality

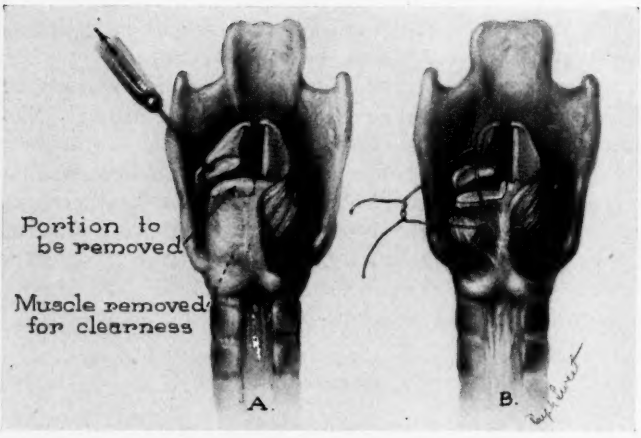

Fig. 3.—*A.* Detail of area of cartilage removed from the posterior superior border of the cricoid cartilage. This is the new site for the arytenoid cartilage. *B.* Areas and direction for the placement of the fixation suture.

to the voice that might lead me to believe the owner had had intimate contact with more than average quantities of potable ethyl hydrate. The patient's past history shows adequate background for this conclusion. This permits the assumption that the operation is not entirely responsible for the slight coarseness.

Examination of the larynx by the indirect method two months after operation showed the left (operated side) arytenoid to be about five degrees to the left of the midline. There was no rotation on the long axis. Had there been any rotation of this type, it would have resulted in the processus vocalis appearing as either a depression or a promontory. The left cord was taut, of normal color and contour. On phonation both cords were on the same level and the edges approximated in a normal manner. Hypercritical examination permits the decision that there is slight bowing in the middle portion of the left cord. The left arytenoid is immobile. One abnormal finding was noted. On phonation the soft tissues containing the cartilages of Santorini and Wrisberg were pulled mesially but also tipped backward and downward. Undoubtedly this was due to the action of the arytenoideus muscles. This aberrant motion is of interest but of no importance except to establish the fact that the arytenoideus

was still functioning. If this muscle still functions it is not logical to believe that it was paralyzed prior to operation. This permits conjecture as to the etiology of the ankylosis of the left arytenoid in the position of extreme abduction. I cannot present logical reasons to explain this fixation of an arytenoid in a position of moderate or extreme abduction in the presence of functioning adductor muscles. The numerical value of the two adductor muscles greatly outweighs that of the single abductor. Mental gymnastics permits theorizing on the role localized infection and spasm of the cricoarytenoideus posticus muscle might play. In this case, trauma was not the etiologic factor.

The result obtained in this case leaves no question as to the value of the procedure and fully sustains the contemplated results proposed by the originator. If the technique as outlined is followed with a moderate degree of accuracy, similar results should be obtained in other patients. The feasibility and relative simplicity of the procedure suggest that it be employed in instances wherein the degree of abduction and the accompanying disability is less than presented by this patient. Whether or not there is fixation of the cricoarytenoid joint prior to operation is unimportant. The inability of one cord to perform its part in the function of closing the glottic space on phonation and the inability of the opposite member to compensate for this defect are the important diagnostic criteria. It is true that in this instance the patient had nothing to lose if the operation proved to be wholly unsuccessful. Now that the ground work has been covered there is no reason why it should not be employed to establish a degree of tautness and midline position in any larynx where there is disability due to unilateral paralysis. If one cord functions properly the fixation of the paralyzed member will diminish or eliminate the spill of air through the glottic chink during phonation and still leave adequate available space for respiration. The operation does not carry with it a higher mortality rate or greater opportunities for complications or unpleasant sequelae than any other surgical procedure involving these structures. Thus far the mortality rate of the King Operation has been zero and the complications have been confined to those attending local infection. A review of the age group subjected to this latter procedure will show that a number of the patients were in the sixth and some well into the seventh decade.

SUMMARY

1. This paper presents a successful result obtained by a new surgical procedure (Reverse King Operation) for restoration of function in cases of aphonia due to nonfunction of one vocal cord.

2. The surgical procedure is as originated and outlined by Dr. Brien T. King.

3. In this case the ankylosed arytenoid was moved from a position of extreme abduction to the midline and fixed in that position.

4. Instead of merely suturing the arytenoid in the midline position, it is placed in an area prepared by removing a portion of the upper mesial posterior edge of the cricoid cartilage. This facilitates the placement of the suture and enhances the probability that the arytenoid will remain fixed in the midline position.

5. The removal of the described portion of the cricoid cartilage permits the placement of the arytenoid in the midline without distortion of the position of the vocal cord. Owing to the advantages it presents, it should be incorporated as part of the routine technique. There is one possible rare exception. The portion of cartilage should not be removed if the articular surfaces are level with the ridge between the joints.

6. The procedure is logical, relatively simple and has produced the desired results—a functional voice and an adequate airway.

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LXXX

A CLINICAL AND PATHOLOGIC STUDY OF TONSIL TAGS

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AND

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If current medical literature may serve as an index of the interest manifested in tonsil tags, it seems evident that the subject is not being recognized universally and regarded with the full significance its clinical importance should demand. This statement is based on a review of the literature and correlation with the fact that tonsillectomy is now a procedure commonly performed by a great number of physicians and surgeons other than those specially trained in that field of medicine and surgery.

In 1914 Billings[1] wrote: "In locating a suspected focus one must make thorough and often repeated examination. One often will need the aid of specialists qualified in nose, throat, jaw, pelvis and other diseases . . . Small faucial tonsils and healed stumps after tonsillectomy are often more dangerous as the seat of chronic abscess than big indurated tonsils."

The role of infected tonsils has long been considered in its etiologic relationship to symptoms associated with the concept of focus of infection.[1-3] Since focal infection is no longer generally regarded as a theoretic concept but as a definite pathologic entity,[4] it becomes more clearly apparent that the status of residual or regenerated tonsil tissue should be studied.

An effort has been made in this study to determine the present status of tonsil tags from a clinical and pathologic standpoint.

Thesis submitted by Dr. Gooch to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Otolaryngology and Rhinology.

EMBRYOLOGY OF TONSILS

The tonsil is formed[5] in the sinus tonsillaris from the second visceral cleft. It appears first as a smooth depression of the mucous membrane, but at about the fourth fetal month downgrowths of the epithelium occur which ultimately are converted into the crypts. Accumulations of lymphoid cells occur about the downgrowths and form the bulk of the tonsil. The secondary germinal centers are not formed, at least in the rabbit and guinea pig,[6] until after birth.

ANATOMY OF TONSILS

The palatine or faucial tonsils are situated between the glossopalatine and pharyngopalatine arches at the junction of the mouth and the pharynx. The surface is covered by stratified squamous epithelium which penetrates for varying depths into the substance of the tonsil as crypts. From ten to twenty crypts may be seen. The configuration of the crypt may be short and simple to long and tortuous. The crypt may reach the depth of the gland to the capsule. The epithelium may be seen to blend insensibly with the substance and stroma of the gland near the terminal extent of the crypt.

The tonsillar stroma consists of thin fibrils of connective tissue which sometimes appear to be interlacing. It varies considerably in amount. The stroma also forms trabeculae and blends with the connective tissue capsule which usually receives some muscle fibers from the superior constrictor and palatopharyngeus muscles.

The bulk of the gland is composed of lymphoid tissue arranged in primary and secondary nodules. In the crypts and frequently in the epithelium are seen collections and single cells of lymphoid and other types of leukocytic structure.

PHYSIOLOGY OF TONSILS

The number of theories concerning the function of the tonsil is prima facie evidence of lack of substantial support for any one of them. The literature was particularly swollen with the subject during the period of establishment of the present concept of focal infection. Recently Waldapfel[6] reviewed the problem.

That the tonsillar tissue is part of the general lymphatic system is generally agreed. It is particularly akin to the lymphoid patches in the intestinal tract. The relationship to the general lymphatic system is different in the respect that the tonsil is exposed to the external environment with only a thin protective covering of epithelium intervening.

By virtue of its physical presence the tonsil probably modifies the voice somewhat. One of us (H.I.L.)[7] has said that removal should not affect the singing quality but may lower the range to a small extent. Hypertrophic or large tonsils frequently impede the passage of air in respiration. This is more common with the nasopharyngeal tonsil than the faucial tonsils; however, it is not infrequent that both are involved. The etiologic effect on otitis media due to the harboring of infection is well known, also.

The function of the tonsil has been thought to depend largely on the secondary lymphatic centers described by Flemming[8] in 1885. He attributed to these centers the function of lymphocytogenesis. Hellmann[9] stated that these centers were not germinative centers but centers of reaction, possessed with phagocytic and immunizing properties of a local and general nature in the defense of the organism. Secretory products resulting from immunologic response to foreign substances have not been demonstrated, but Hellmann and White[10] found increased numbers of secondary nodules during processes of immunization.

Through vital staining methods of study applied to human tonsils, Taillens[11] reached an agreement with Hellmann's theory. Taillens further concluded that practically the experiments recall the controversy between the "defensive" and the "infection" theories. The tonsil is primarily serving as a defensive mechanism, but once the barriers have been overpowered it becomes a source of danger. The nature, virulence and mass of the aggressors are factors in the fight, but probably the most important role is determined by the quality of the tissue.

The presence of emigrating lymphocytes is generally recognized histologically. They are commonly seen in various parts of the epithelium covering the tonsil and in the saliva as salivary corpuscles. Kelemen[12] concluded that the movements of the tonsillar lymphocyte represent in their entirety a passive transportation along preformed highways. The mobile elements in the germinal, or action, center according to Kelemen are driven by increased intranodular pressure into the meshes of the reticulum. Portions of the reticulum penetrate into the layers of the epithelial cells. These projections of the reticulum carry the mobile elements within themselves. Increasing pressure causes these structures to expand and rupture the epithelium so that the cells are conveyed into the lumen of the crypt. Here they are carried along threads of fibrin to reach the mouth of the crypt and are helped to reach the free surface of the tonsil by a tuftlike disposition of fibrinous fibrils. Changes in pressure initiated in the

blood vessels of the capsule are responsible for the formation of the secondary nodule and the transportation of the mobile elements.

Révész[13] stated that action of muscles in the process of deglutition exerted pressure on the tonsil which expressed the contents of the crypts.

HISTORY OF TONSILLECTOMY

To understand fully the more common attitude of general lack of regard for tonsil tags not conspicuously diseased, it appeared desirable to inquire into the history of tonsillectomy.

Celsus,[14] the Roman medical writer who flourished in the first century, spoke with such familiarity of surgical removal of the tonsils as to indicate that it was a common practice even though this was the first mention of the procedure in the literature. He wrote: "Tonsils which remain indurated after inflammation, if covered by a thin membrane, should be loosened by working the finger around them, and then torn out; but when this is not practicable, they should be seized by a hook and excised with a scalpel." In 490 A. D. Aetius[15] wrote: "The portion which projects—that is, about one-half of the enlarged gland—may be removed; those who extirpate the entire tonsil remove at the same time structures which are perfectly healthy, and in this way give rise to serious hemorrhage." The fear of hemorrhage must have been of utmost importance since mention of it is frequent in the early writings on this subject. Paulus Aegineta[16] in 750 A. D. described a procedure in which the tonsil was seized and pulled outward by a tenaculum and cut out by the root. During the operation the patient's head was held and his tongue depressed by assistants.

After Aegineta, Glover[17] found no mention of the operation for several centuries. She noted that even Ambroise Paré[18] in 1509 advised tracheotomy when serious enlargement of the tonsils existed; however, his pupil, Guillemeau,[19] ligated or removed diseased masses although he did not advocate removal of the entire tonsil.

In 1734 Wiseman[20] revived the operation and it began to be more widely practiced with little change in procedure. When Caqué,[21] in 1757, commenced to excise tonsils at Hotel Dieu, Rheims, it became a recognized operation and the fear of hemorrhage was minimized. Instruments were improved; almost every surgeon modified those used by his predecessors. In the method most generally favored a bistoury or a pair of scissors with curved or straight

blades was generally employed. An assistant depressed the patient's tongue; the surgeon seized the tonsil with a vulsella, drew it out and cut off as much of it as he could. About 1880 the guillotine and the wire snare came into use. A general anesthetic was seldom given, but sometimes potassium bromide was given in large doses for several days before the operation.

Furstenberg[22] credited the use of the galvanocautery for the reduction of hypertrophied tonsils as having been practiced from the early eighties. He called particular attention to the number of sittings required and the disagreeable aftereffects.

In 1901, Thomson[23] reported 2 cases in which he removed the tonsils by enucleation or dissection with curved scissors and the fingers. In 1909 Waugh[24] observed that 143 of 900 patients failed to obtain relief from the symptoms for which primary tonsillotomy was performed. He compared the mode of development and structure of a tonsil to that of an ordinary lymph gland and reasoned that tonsillotomy violates the principles which would similarly obtain in treatment of a diseased lymph gland, and suggested that tonsillectomy had been generally regarded as too difficult. The fear of bleeding had continued to prevail up to that time. Waugh then described a method of dissection for removal of the tonsils.

Tonsillotomy from this time came to be viewed more and more critically. This was recorded in the discussions following the papers on tonsillectomy versus tonsillotomy presented by Burger[25] and Goodale[26, 27] at the Seventeenth International Congress of Medicine in 1913. Otolaryngologists from various parts of the world were represented and the observation was made that after tonsillotomy 25 to 50 per cent of the patients had recurrences which necessitated further work. The preponderance of those present concurred in the opinion that tonsillectomy was the operation of choice.

DEFINITION OF A TONSIL TAG

A tonsil tag may be defined as any remnant of palatine tonsil tissue in the tonsil fossa after tonsillectomy. In proposing the above definition we assume that in the performance of a tonsillectomy the portion of the plica triangularis adjacent to the tonsil was removed. The edematous plica may frequently be misinterpreted clinically as a tonsil tag. This is readily understood because of its proximity to the tonsil fossa which usually becomes diminished in depth as a result of contracture of the granulation tissue which appears in the healing process after tonsillectomy.

ETIOLOGY

Grichter and Pearlman[28] and Leshin and Pearlman[29] ascribed the presence of tonsil tags to hypertrophy, sometimes after the lapse of a long period, of microscopic extratonsillar lymphoid material which was not, or could not be, removed at the time of operation. Baum[30] claimed to have demonstrated extracapsular lymphoid tissue histologically, both in the pillars and in the floor of the fossa, which was structurally identical with that of the tonsil itself, but which was entirely extracapsular and ordinarily would not be removed at operation. Roberts[31] stated that lymph nodes existed in the fascia which often lines the fossa after tonsillectomy and these may hypertrophy and partially fill in the fossa with lymphoid tissue. On the other hand he stated: "Evidence that a tonsil thoroughly removed ever grows is lacking."

Cooke[32] stated that it is infection in the tonsil tissue remaining after operation that stimulates lymphoid overgrowth. This overgrowth may progress to involve the pharynx in a state of lymphoid hyperplasia. That tonsils do not recur is the most widely held opinion among those who have studied the problem in more recent years.[31-35]

Instruments of the nature of the Sluder tonsillotome have been charged with being the cause of tonsil tags. The wire snare type of instruments have been condemned likewise. One of us (H. I. L.) is of the opinion that it is not a good surgical principle to grasp anything with an instrument not possessing the facility of readily releasing it. In his experience with the snare in the performance of three tonsillectomies, he stated: "It worked well the first time, broke the second time, and the third time it became inextricably caught in the tissue and required dissection for the completion of the operation."

That tonsil tags are often difficult to recognize has been noted by Nissen[36] and others.[1, 35] Inflammation renders elusive bits more distinguishable. In Mosher's[37] discussion concerning tonsil tags as foci of infection, he commented that "the average operating skill in tonsillectomies will have to be better than it is at present, with everyone who needs the added income feeling that he can do a tonsillectomy anywhere at any time and with any instrument, including the index finger." Cooke stated: "A tonsillectomy should command all the respect of a major operation though unfortunately it often does not. Since nearly one-half of these operations on patients from my clinic at the Roosevelt Hospital are secondary, the general operative work cannot be judged very skillful . . . "

INCIDENCE OF TONSIL TAGS

In the Literature.—During the clinical examination of throats of 212 school children, Coues,[38] in 1910, noted that 43 had had some sort of operation on their tonsils. Forty of the latter group were examined carefully again and 12 (30%) had hypertrophic tonsils. In 1913, Clark[39] surveyed the results three to four years after tonsillectomy in a series of cases at the Massachusetts General Hospital. He reported that 59 of 143 patients examined had tonsil tissue remaining; in 31 it was bilateral and in 28, unilateral.

In 1928, Rhoads and Dick[40] examined 403 student nurses who had had tonsillectomies. Two hundred and ninety (about 73%) had tonsil tags.

In the same year, Paton[41, 42] reported 53.8% of the patients in his group had tags.

In 1930, McLaggan[43] examined 100 school children for the presence of tonsil tags which he classified as "one quarter to the whole of" the tonsil remaining and found that 49% had tags. Bradley[44] in 1930 also reported his study of tonsillectomy and adenoidectomy in 167 cases. He regarded eradication of the tonsil tissue clinically complete in only 18%.

In 1937, Epstein[45] reported observations on 540 children, aged 2 to 13 years, for as long as two years after tonsillectomy. Hypertrophied lymphoid tissue was noted in 336 patients and was especially prevalent in children less than 4 years of age and least so in those more than 10 years of age.

Campbell[46] observed 621 tonsillectomized girl students in the course of examinations prior to their entrance to a university in 1939. Tonsil tags were found in the fossae of 77.3%.

Among 1,000 tonsillectomized children whom Kaiser[47] examined in 1930, ten years after operation, 381 (38.1%) had evidence of tonsil tissue remaining. The incidence of otitis media and cervical adenitis in those with tonsil tags was greater than among those in whom tonsillectomy had been complete. Furthermore, sore throats, head colds, repeated attacks of fever, laryngitis and diphtheria occurred somewhat more often in those children in whom the operation had been incomplete.

Lüscher[48] observed 224 patients on whom he had performed tonsillectomy from one to twelve years after operation. Seventy-two (32%) had tonsil tags. Sputh and Sputh,[49] in 1946, examined 285 patients who had undergone tonsillectomy and found that 228

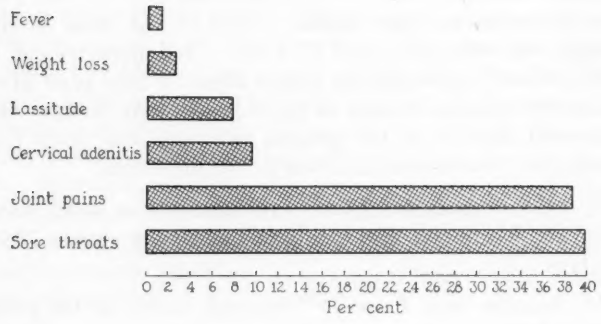
Fever
Weight loss
Lassitude
Cervical adenitis
Joint pains
Sore throats
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
Per cent

Fig. 1.—Incidence of common signs and symptoms in cases in which secondary tonsillectomy was performed.

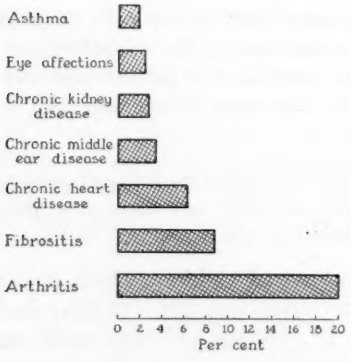

Fig. 2.—Incidence of associated diagnoses in same cases as Fig. 1.

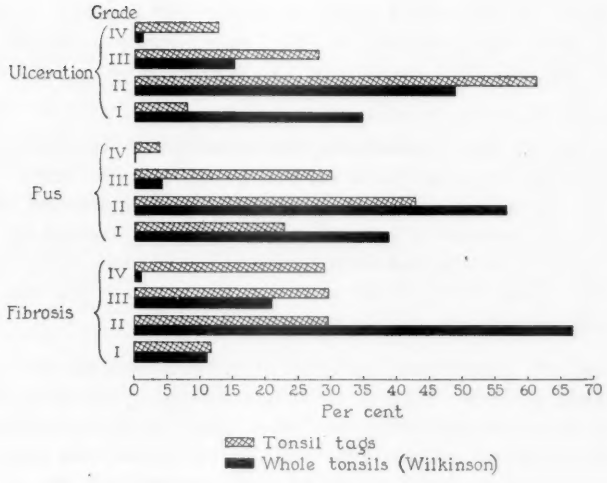

Fig. 3.—Relative degree of ulceration, keratinization, presence of pus and fibrosis in 159 tonsil tags, and comparison of related findings in tonsil tags from the present study with those found in whole tonsils by Wilkinson.[51]

(80%) had had tonsil tags. They estimated that at least 75% of the tonsil tags in this group were infected.

Among Patients at the Clinic at Time of Admission.—In order to determine the present incidence of tonsil tags among patients at the Mayo Clinic, the records of 400 consecutive newly admitted patients in 1946 were examined. Of that number 72 were admitted for emergency measures, special examinations, such as refractions of the eyes, obstetrical procedures or were newborn. These were not included in the total for calculating the incidence because complete examination was not given, or not recorded.

The remainder were seen by members of the clinical sections in the clinic. Cases may be divided into two groups: (1) those in which examination was performed in the general clinical sections only and (2) those in which examination was performed in the clinical sections and later in the ear, nose and throat section as a routine measure.

In the first group there were 219 patients, only 4 of whom were found to have tonsil tags. Their respective ages were 7, 40, 49

and 52 years. In the second group there were 109 patients. Tonsils of 52 of these 109 patients (47.7%) were cleanly removed; 42 (38.5%) still had their tonsils and 15 patients (13.8%) had tonsil tags.

The ages of the 15 patients in the second group who had tonsil tags varied from 24 to 66 years; the average age was 39.4 years. The mode[50] for new admissions at the clinic according to a previous study is 32 years for men and 37 years for women, so the average age for patients with tonsil tags was little greater than the mode for patients in general. Thus, 22.4% of 67 patients in the second group who had had tonsillectomies had conspicuous tags remaining.

Since both groups were made up of patients who did not come to the clinic primarily because of otolaryngologic symptoms, observation in these cases has led us to believe they are representative of the entire group of patients who come to the clinic, and since the otolaryngologists are better qualified than members of the general sections to recognize tonsil tags, the incidence of 22.4% may be considered as the incidence of tonsil tags among clinic patients who have had tonsillectomies previous to their first admission. The difference in the incidence of tonsil tags in the two groups studied may be considered as a rough indication of the need for obtaining the assistance of a qualified otolaryngologist in examinations of the tonsils.

To determine whether or not the incidence of tonsil tags was increasing or decreasing, the percentage of secondary operations for removal of tonsil tags in relation to tonsillectomies and to tonsillectomies and adenoidectomies for thirteen years was computed. This included the years 1934 through 1946. The lowest incidence was in 1937 when 7.4% of operations in this category were for removal of tonsil tags. The greatest incidence was in 1940 when the percentage rose to 10.5. The average for the thirteen years was 8.8%. From this it is apparent that there has been no significant change in the incidence in the period studied.

CLINICAL OBSERVATIONS ON PATIENTS WITH TONSIL TAGS

Material Studied.—The clinical records of all patients who underwent operations for removal of tonsil tags at the Mayo Clinic during the years 1943 and 1944 were reviewed. There were 171 patients. One reason for selecting 1943 and 1944 was that chemotherapy was well established by that time. This was done to show that the problems of infected tonsils and tonsil tags are not solved by chemotherapy. Furthermore the period was sufficiently remote to

warrant the belief that the patient would have returned for further observation if the primary condition for which he presented himself had not improved. So few have returned, or have returned with other complaints, that no definite conclusions could be drawn without further study which might be accomplished only by further examination of the patient. It did not appear a practical procedure to contact the patient by letter in a matter of this sort.

Difficulty of Detecting and Evaluating the Condition of Tonsil Tags.—In the entire group only 10 patients were seen primarily by otolaryngologists for whatever reason they presented themselves. The remaining 161 were referred for one reason or another to the otolaryngologists from the general medical sections of the clinic. In 56 of this group, the clinician recorded that tonsil tissue had been observed. In other words, in only approximately a third of the cases were the general clinicians able to detect the tonsil tags. This difficulty can be further emphasized by pointing out that these were all cases in which the otolaryngologist regarded the tags to be of sufficient pathologic import to require surgical removal of the tissue. It has been demonstrated that the incidence of tonsil tags is about 22.4% among tonsillectomized patients registering at the clinic. When it has been shown that tags are so frequent and so difficult to observe clinically, it follows that considerable reliance should be placed in qualified otolaryngologists for this purpose.

Sex and Age Incidence.—There were many more women (103 or 60.2%) than men (68 or 39.8%) in the series. The ages of the patients varied from 8 to 63 years, the average age being 37.6 years. The greatest incidence was in the fourth decade; 32.2% of all the patients were in this decade of life. The third and fifth decades were about the same with 20.0% and 21.6% of the patients, respectively; 14.0% of the patients were in the sixth; 8.8%, in the second; 3.0% in the seventh, and 0.6% in the first decade.

Common Symptoms and Signs.—The most common symptom, although infrequently the chief complaint, was that of sore throat, and 68 patients (39.8%) made this complaint. Thirteen (7.6%) described a single attack and 55 (32.2%) had had multiple attacks. In 2 cases sore throat had not been common until after the initial tonsillectomy. One patient described 26 attacks of quinsy in six years; the first appeared soon after the primary tonsillectomy. Sixty-seven patients (39.2%) complained of pain in the joints; 16 (9.4%) of cervical adenitis; 13 (7.6%) of lassitude; 4 (2.3%) of loss of weight, and 2 (1.2%) of some fever (Fig. 1).

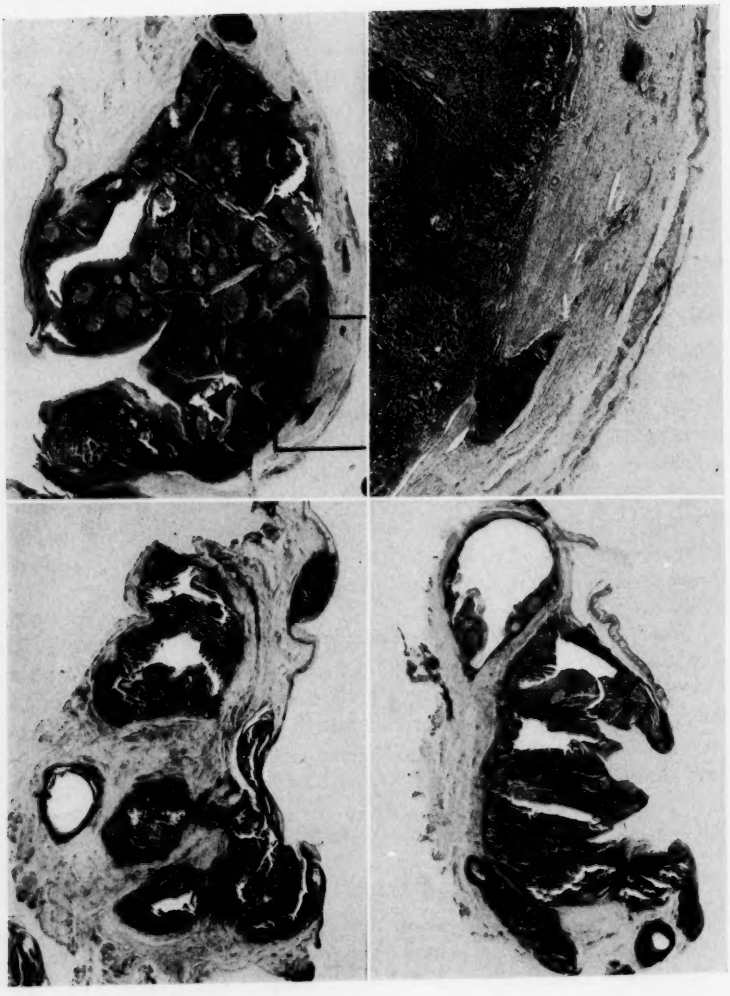

Fig. 4.—An entire section of a tonsil tag, particularly demonstrating isolated bits of lymphoid tissue in the thickened capsule (x4).

Fig. 5.—Greater magnification of the portion indicated by the blocked-off area in figure 4, demonstrating "pinching off" of lymphoid tissue by the increase in fibrous tissue in the capsule (x32).

Fig. 6.—Relationship of a cyst to lymphoid tissue in markedly fibrosed tonsil tag. In time it is suspected that the widely separated lymphoid masses would have been changed into cysts by increase in fibrous tissue as a result of reaction to repeated bouts of infection. The cyst isolated from glandular tissue and lined by stratified squamous epithelium should be noted (x9).

Fig. 7.—Tonsil tag showing three cystic areas with persistence of some lymphoid structure within them (x6½).

Diagnoses Associated with the Presence of Infected Tonsil Tags.—Associated diagnoses incident or concomitant to the diagnosis of infected tonsil tags were made in all cases (Fig. 2). These were definite diagnoses established in the course of the examinations during the time that the patient was actively under observation at the clinic, and at which time the secondary tonsillectomy was performed.

All definitive diagnoses of arthritic conditions were grouped together, constituting the greatest number in this series of patients requiring secondary tonsillectomies. This number was 35 (20%) of the total number of patients. Fifteen (8.8%) more received a diagnosis of fibrositis.

Eleven (6.4%) had chronic heart disease; 6 (3.5%) had chronic disease of the middle ear and 5 (2.9%), chronic renal disease. Four patients (2.3%) had associated ocular affections; 2 of these 4 had iritis, 1 conjunctivitis, and 1 retinitis. Two patients (1.2%) had bronchial asthma, and 1 (0.6%) had asthmatic bronchitis.

Leukocyte Counts.—The leukocyte counts varied from 2,700 cells per cu. mm. of blood to 16,700, the average of the 136 instances in which it was recorded being 8,380. Counts were taken during the course of examination prior to operation.

Sedimentation Rates.—In 105 cases the sedimentation rate of cells was determined prior to operation. It varied from 1 to 120 mm. in one hour (Westergren), the average being 21.7.

Previous Operative Procedures on the Tonsils.—Data concerning the number of tonsillectomies were available in 150 cases. Including the one at the clinic we found that 130 patients had undergone two operations; 16, three; 3, four; and 1, six operations. The average number of operations per patient in this group was 2.17. Electrocoagulative measures had been applied to the tonsils of 11 patients as a procedure designed to remove them. In some instances the patients described at least five applications of electrocoagulation. Electrocoagulative measures were considered as one attempt at tonsillectomy in each case, regardless of the number of applications. One patient who had undergone surgical removal initially and electrocoagulation later, still had a tonsil tag for which sharp dissection was required for complete removal.

Location of the Tonsil Tags.—In 46 cases the tonsil tags were unilateral, in 27 of these cases they were on the right and in 19 on the left side. This was an interesting observation, because the right

tonsil is easier to remove for the right handed surgeons. Perhaps higher incidence of tonsil tags on the right side was due to the fact that the "easier" tonsil was removed first, and by the time the second or left tonsil was attempted the dexterity or proficiency of the surgeon had improved.

Two patients had infected adenoid tissue which required removal, in addition to the tonsil tags.

Interval after Primary Tonsillectomy.—The interval between the primary tonsillectomy and the one at the clinic was noted in 139 cases (Table 1). The average number of years beween primary and final operation was 18.5.

HISTOPATHOLOGY OF TONSIL TAGS

The literature on pathologic studies of tonsils was reviewed by Wilkinson[51] at the time he reported his results. No histopathologic studies of tonsil tags were noted. Wilkinson mentioned that the few tonsil tags in his series were so well diluted in the great volume that the results were not influenced by their presence, nor were any conclusions drawn regarding the tags alone.

Material Studied.—The tonsil tags removed in 1943 and 1944 from 100 consecutive patients were obtained and regarded as representative material for study. These specimens did not include the so-called diathermy tags, or tonsil tags resulting from electrocoagulation procedures intended to remove or destroy the tonsil. The latter were segregated and studied separately.

The tags were prepared by obtaining for preparation of microscopic slides a section as nearly as possible from the center of the formalin-fixed specimen. No effort was made to get more than one cross section from each specimen. The block was sectioned by the microtome after quick freezing, mounted on a slide, and stained with hematoxylin and eosin. This work on the histopathology of tonsil tags was done with the help and under the supervision of Dr. Parkhill.

From the 100 cases there were 159 tonsil tags: in 41 cases single tonsil tags were present; in the remainder, bilateral tags. The 159 tonsil tags were studied individually as it was evident that considerable variation existed even between paired tonsils from the same person. A rough estimate for the purpose of illustration is that approximately a third of the paired sections showed from 25% to 75% variation in the amount of fibrosis present.

Fig. 8.—Compare with figure 7. There is marked fibrous tissue replacement about the large filled cyst, which illustrates the end-result of repeated infections (x6).

Size of the Tags.—The size of the sections varied from 2 mm. to roughly 2 cm. in diameter. This represented that which appeared as a small rounded patch of lymphoid tissue in the tonsil fossa, as well as that which might have been a hypertrophic tonsil not considered to have been reduced in size by previous operative procedures.

Ulceration.—Ulceration of the cryptal epithelium was present in approximately half (75) of the entire number of tonsil tags. The degree of ulceration was graded by the method of Broders[52] on the basis of 1 to 4, as were the degrees of pus present, fibrosis, and keratinization. The frequency by grade is shown in figure 3. Abscess formation in the region of the crypts was present in 2 tags.

Keratinization.—Keratinization was regarded generally as a physiologic phenomenon by Wilkinson. It appeared, however, to be increased in amount and incidence in the tonsil tags studied when compared with whole tonsils (Fig. 3). This finding coincides with what would be expected in the presence of cryptal stasis.

Pus.—The incidence of pus in the crypts is shown in figure 3. More will be said of it later.

Fibrosis.—Perhaps the most striking general feature consistently present in the tonsil tags was the fibrosis. This is interpreted as representative of the cumulative effects of disease. Even though some degree of fibrosis may have been present prior to the initial attempt at tonsillectomy, it is believed considerable fibrotic replacement was imparted as a result of the healing process after operative trauma.

The fibrosis was present in the subepithelial tissue, parenchyma, trabeculae, capsule, and in some instances in the contiguous muscle fibers.

In approximately 25% of the tonsils the crypts were dilated and distended, and frequently what was interpreted as a flattening of the lining of stratified squamous epithelium was associated. This appearance suggested that the lumen was obstructed or that the supporting framework or reticulum had been indurated by fibrosis to such extent that elasticity or compressibility was lost. Induration in turn had impeded discharge of cryptal contents whether it was accomplished by changes in the volume of the tonsil, or by the squeezing of the gland by adjacent muscles in the process of deglutition. This had established stasis in the crypts and produced suitable soil for infections. Fibrosis also may interrupt the pathways of lymphocytes described as a normal process by Kelemen. This is true of the subepithelial fibrosis present as a result of inflammation or of surgical trauma in the initial operation. Fibrosis occurred subadjacent to the crypts as a result of abscess formation and inflammation. Undoubtedly more could have been demonstrated in the crypts by serial sections.

A fairly typical condition is shown in figures 4 and 5. The capsule (Fig. 4) was thickened by an increase in the fibrous connective tissue. In the capsule can be seen isolated bits of lymphoid tissue which represent a condition frequently seen in this material. One portion of the section is shown under greater magnification (Fig. 5) and illustrates the pinching off of a segment of lymphoid structure and the practically complete encasement of it by fibrous tissue. In this instance it maintained a connection by continuity of lymphoid tissue supported by its characteristically delicate reticulum. Such a structure certainly may become infected by the continuity of tissue.

The arrangement of the secondary germinal centers disclosed nothing that could not be explained on the basis of distortion or replacement as a result of fibrosis, presence of distended crypts or abscess formation.

A clearer picture may be obtained by putting some of these features together. Fibrous tissue in the substance of the gland subjacent to the epithelium was increased. The deeper part of the capsule commonly exhibited thickening due to increase in the fibrous tissue of the capsule itself as well as the contiguous area where the muscles are attached. There was increased fibrous tissue in the trabeculae accompanying the blood vessels. The sum of these changes provided a gland with relatively little elasticity compared to a normal tonsil. In the presence of infection, resistance to swelling certainly must have been present. This fact suggests that there was impedance to promotion of increased blood supply required for combating infection, or a lowering of resistance in the gland because of physical alteration due to the apparent fibrosis. This fibrosis partially obstructed the physiologic phenomena normally associated with infection. This is probably the reason quinsy develops in patients with tonsil tags who were free from it prior to attempts at tonsillectomy. By the same process undoubtedly many similar but subclinical conditions occurred. These were manifested simply by the prevalent sore throats.

Examples of cystic areas lined by stratified squamous epithelium believed to have become isolated as a result of operative trauma and subsequent fibrous replacement or scarring are shown in figures 6 and 7. Surgical operative reports occasionally contain a statement that the gland "collapsed like a balloon" with expression of caseous material during the operation; such instances are in all probability exemplified by the specimen shown in figure 8. Surgical trauma undoubtedly expresses the contents of the larger cysts and prevents demonstration in histologic preparations.

Fibrosis is unquestionably greater in tonsil tags from patients of older ages, but the average age of the group who had fibrosis designated as grade 4 in the observations presented in figure 3 was only 38 years. It included patients as young as 12 and as old as 55 years of age. When the related findings in this group of cases were compared with those on whole tonsils studied by Wilkinson, a much greater incidence of severe fibrotic changes were found in tonsil tags (Fig. 3). The same pertains in comparison of the incidence of higher grades of ulceration and pus in the two groups. This comparison suggested that the tags were more susceptible to infectious processes than were whole tonsils. Likewise, it demonstrated the greater degree of prevailing infection in the tags. The tag, therefore, must be considered a more dangerous entity than the whole tonsil.

Other findings of some consequence and interest included the presence of bone and cartilage. In the 159 tags there were only 2 which contained bone and cartilage, and they were from the same patient.

One tonsil tag contained colonies of actinomycetes or actinomycoid organisms. This patient had had multiple sore throats, lassitude and cervical adenitis. The primary tonsillectomy had been performed fourteen years previously.

Diathermy Tags.—The tags resulting from electrocoagulative measures to remove the tonsils showed no less fibrosis than grade 3. Eight pairs (they were bilateral in all instances) exhibited fibrosis, grade 4. The general picture was one of greater distortion and scarring than in the tags which followed the surgical tonsillectomies. The amounts of pus, ulceration and keratinization were present in more marked degree. This indicated greater adverse pathologic qualities in spite of the fact that this group was much smaller in number. One tag had colonies of actinomycosis in the crypt. Two pairs showed cartilage, and one pair showed bone with the cartilage. An unidentified foreign body was demonstrated in the crypt of one tag.

SUMMARY

From this study of cases of tonsil tags at the Mayo Clinic and of the literature on this subject it is clear that the physiology of the tonsil is poorly understood. This study also indicates that the presence of tonsil tags is difficult to demonstrate in many instances, and reliance should be placed on qualified otolaryngologists for this examination.

The common associated signs and symptoms of 171 patients who underwent operation for the removal of tonsil tags at the clinic in order of frequency were (1) sore throats, (2) pain in the joints, (3) cervical adenitis, (4) lassitude, (5) loss of weight and (6) fever. The common associated conditions diagnosed in patients undergoing operation for removal of tonsil tags, in order of frequency, were (1) arthritis, (2) fibrositis, (3) chronic heart disease, (4) chronic disease of the middle ear, (5) chronic renal disease, (6) affections of the eyes and (7) asthma.

The cause of tonsil tags is incomplete removal. Complete removal can be accomplished only when the thickened capsule is removed by sharp dissection.

The average tonsil tag can be described compositely as a bit of tonsil tissue of varying size covered by stratified squamous epithelium

TABLE 1.

INTERVAL BETWEEN PRIMARY TONSILLECTOMY AND SECONDARY REMOVAL.

INTERVAL, (YRS.)	CASES	INTERVAL, (YRS.)	CASES
1	1	21	3
3	3	22	3
4	2	23	3
5	3	24	7
6	7	25	4
7	8	26	5
8	5	28	5
9	3	29	2
10	3	30	3
11	3	31	7
12	3	32	1
13	2	33	2
14	7	34	2
15	6	35	2
16	6	36	2
17	2	37	1
18	8	39	2
19	4	40	1
20	5	49	2

which also lines the crypts. The crypts contain increased amounts of keratin, cellular debris and leukocytes. Stasis, as a result of induration, is present in the crypts, a condition which provides suitable soil for infection. Ulceration of the epithelium lining the crypt is frequent. The lymphoid elements continue to be arranged in characteristic pattern with germinal centers remaining when a sufficient amount of the lymphoid tissue is present. When the lymphoid tissue is of such scant amount that only nests of it without germinal centers are seen, the stroma of the gland shows considerable increase in fibrous connective tissue, particularly in the subepithelial area and in the trabeculae in which the blood vessels course. The capsule is thickened and may contain isolated bits of lymphoid tissue or cystic areas of varying size. The entire gland is indurated and inelastic when compared to a normal whole tonsil. Tonsil tags were found to be more dangerous from a standpoint of infection than are whole tonsils. Diathermy tags studied presented the same pathologic qualities as those of operative tags but in greater degree.

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LXXXI

TUBERCULOSIS OF THE MIDDLE EAR AND THE TEMPORAL BONE

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Tuberculosis of the middle ear, mastoid, or the temporal bone has been brought to your attention many times in literature. I shall not review the history of the condition, but will try to correlate the more recent findings and present two cases of my own. Conclusions by different authors vary because of the type of case studied and are not necessarily contradictory.

During 1942 there appeared two articles besides my own:[4] "Tuberculosis of the Ear" by Proctor and Lindsay,[1] and "Tuberculosis of the Ear and Mastoid in Adults," by Cohen and Koepcke.[2] The latter find "most tuberculosis of the middle ear develops by way of the eustachean tube, there are few blood born infections in adults." Spencer[3] finds that "in adults suffering with tuberculosis, this mode of infection [eustachean tube] is likely the most frequent."

Proctor and Lindsay in their summary state that "tuberculosis of the temporal bone usually originates by the hematogenous route." They base this conclusion on eight cases in patients from 22 months to 14 years of age. Of these, six died of tuberculosis with multiple foci, miliary tuberculosis or meningitis. The remaining two had a localized lesion with fistulae about one ear, and with little or no evidence of pulmonary tuberculosis. These cases may or may not have been hematogenous.

Probably in the majority of cases, tuberculosis developing in the middle ear and going on to bony destruction, is by way of the eustachean tube; but in those far-advanced cases with blood stream infection or miliary tuberculosis, the infection may develop anywhere, and that includes the temporal bone.

The diagnosis is made on the history of the onset, findings of tubercle bacilli in the discharge or tissue, evidence of tuberculosis elsewhere, and x-ray, which shows a change in the mastoid in almost

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all cases of tuberculous otitis media. Cohen and Koepcke reported 90 of 92 cases showing involvement of the mastoid.

X-rays are not reported to be diagnostic, but all the cases of tuberculous otitis media seen at the Essex County Sanitorium with or without clinical mastoiditis revealed a characteristic periantral sclerosis.

Previous to streptomycin, two factors influenced the healing or progression of a tuberculous lesion. First, the resistance of the patient, and second, the virulence and extent of the infection. While it is still too early to conclusively evaluate streptomycin in the treatment of pulmonary tuberculosis and its complications, the results obtained by its use are many times very dramatic. As in the case of penicillin however, it is not a panacea, and must be complimented by other forms of treatment, such as collapse therapy, rest, etc.

Cohen and Koepcke state "under conservative treatment 50% of tuberculous otitis media will heal and surgery should be instituted only when the original focus is under control and there is a continuous aural discharge." Taking these factors into consideration, then, the original focus is the most important factor. The pulmonary lesion, the most common source of infection, must be treated and controlled if the result is to be favorable. This is most important, whether the secondary lesion be in the temporal bone, the larynx, or trachea and bronchi. Local treatment is of little value, with the exception of streptomycin which so far has been used too little to draw any definite conclusions.

The prognosis in those cases of far-advanced pulmonary tuberculosis or in miliary tuberculosis is bad, whether or not there is involvement of the temporal bone. Lindsay and Proctor state, "The dura is extremely resistant to intracranial extension of tuberculosis from the temporal bone. We have failed to find in the literature a case in which it was proved histologically that diffuse tuberculous meningitis was due to direct extension from the temporal bone."

Cohen and Koepcke state that, "meningitis and brain abscess are a part of the miliary or hematogenous spread and tuberculosis of the middle ear is a serious disease only as it affects the hearing. It does not, however, usually affect the prognosis of the patient as far as it concerns life expectancy."

Briefly, it can be stated that the prognosis depends upon the general condition of the patient, his resistance and the extent of the tuberculosis.

CASE 1.—The first case is that of a female in her thirties with far-advanced bilateral pulmonary tuberculosis, who was first treated in 1925. We are particularly interested in her fifth admission in October, 1935. Her chief complaint was dyspnea. On April 14, 1936, she had a right seven-rib thoracoplasty and was receiving artificial pneumothorax on the left. In May that year there was clinical evidence of tuberculous otitis media. In July of 1936 there were clinical symptoms of mastoiditis. In September, 1936 it was noted that the discharge was irregular and that when the ear was discharging, the mastoid signs, that is, pain and tenderness, subsided. During October, 1937, tenderness of the mastoid persisted with otorrhea. Previous to December, 1937, repeated smears and cultures failed to reveal the presence of tubercule bacilli, but at this time many tubercle bacilli were found in the smear, Gaffky X. The symptoms gradually subsided and in March of 1938 the ear was found to be dry. An x-ray had been taken previous to 1936 which revealed normal, pneumatic mastoids. In 1937, there was definite x-ray evidence of bone destruction,while those taken after the ear became dry in 1938 revealed almost complete sclerosis of the mastoid. There was marked loss of hearing of the conductive type with a large posterior marginal perforation.

The ear remained dry until she expired of pulmonary tuberculosis on May 18, 1941.

This patient was very ill and certainly a poor operative risk. She had marked dyspnea at all times, having had a seven-rib thoracoplasty on the right and receiving artificial pneumothorax on the left. Because of this, the only treatment in addition to general treatment was boric acid and alcohol ear drops, alternating with urea solution and dry wipes. The tuberculosis of the ear and mastoid became quiescent after nearly two years of active infection and three years later the patient died, but not from the lesion or any complication of the lesion in the ear and mastoid.

CASE 2.—The second patient, a male aged 20, was admitted in October, 1946, with far-advanced bilateral miliary tuberculosis of the lung. Treatment consisted of rest and bilateral artificial pneumothorax, and in November of 1946 he complained of blocked left ear. Examination revealed a clinically typical tuberculous otitis media. In January, 1947, the moist or slush stage had arrived. On February 20, 1947, a smear taken from the ear revealed tubercle bacilli (Gaffky I) and at this time the patient had a tender mastoid. At this time there was x-ray evidence of mastoiditis. On February 19, 1947, the day before, streptomycin had been started

and this was continued for four months. He received a total of 231 grams in daily doses of 2 grams (½ gram four times a day). On March 15, 1947, approximately one month after beginning treatment with streptomycin, the ear was found dry and has remained dry to date. There are no mastoid symptoms. The Weber test laterializes to the left. Audiograms were made in March, 1947, and February, 1948. Both were made after the ear became dry. The hearing is better now than in 1947.

SUMMARY

Two cases have been presented with very similar clinical findings. One case of tuberculous otitis media with mastoiditis, healed after nearly two years of otorrhea with pain and tenderness about the mastoid most of the time. The second case, with almost identical clinical and x-ray findings, healed after one month of streptomycin therapy with relatively little loss of hearing.

24 WINTER STREET.

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LXXXII

TREATMENT OF CERTAIN TYPES OF DEAFNESS BY ROENTGEN RAY THERAPY

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AND
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GRAND FORKS, N. DAK.

In 1938 Crowe[2] focused attention on deafness resulting from lymphoid tissue obstructing the orifices of the eustachian tubes. He described an effective means of treating this condition with radium. In 1941 Crowe and Burnam[4] concluded the following after studying 1365 children:

"The recurrence of adenoids after operation on young children is so common that it must be regarded as normal. This recurrent lymphoid tissue may impair the function of the eustachian tubes and cause a low grade tubo-tympanic catarrh which may lead to chronic progressive deafness of this type.

"Lymphoid tissue is so sensitive to radiation that the dosage employed in the treatment of the nasopharynx is far below the amount that could cause any irritation or injury to the mucous membrane or surrounding structures.

"Radiation is of no value in the treatment of chronic middle ear suppuration, otosclerosis or any form of inner ear or nerve deafness. It is used for the sole purpose of reducing obstructing nodules of lymphoid tissue, decreasing the secretion of mucus and restoring the normal ventilating function of the eustachian tubes. For this reason radiation is more often beneficial in children than in adults."

These investigators used radon up to 1000 mc. in a specially devised applicator which was passed along the floor of the nose to rest in apposition to the eustachian orifices. With this applicator, a dose of 2 gram minutes may be given to either side of the nasopharynx and repeated at intervals of four weeks or longer without causing irritation or disagreeable symptoms of any kind. Since 1938, Polvogt,[16] Fowler,[10] Emerson and Dowdy,[7] Boies,[1] Fisher[9] and many others have confirmed these observations. Jarvis,[13] O'Brien,[15] Eagle and Reeves[6] have reported on the use of roentgen rays in the treatment of catarrhal deafness and to eradicate pharyngeal lymphoid tissue.

Microscopic investigations by Farrior,[8] and by Fowler, Jr.,[11] have revealed lymphoid tissue in the middle ear cavity as well as

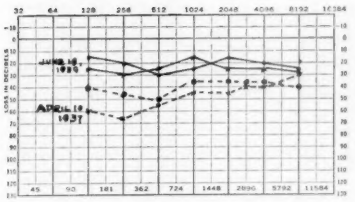

Fig. 1. Case 1.

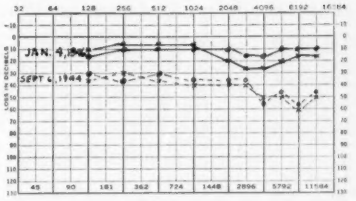

Fig. 2. Case 2.

along the eustachian tube; although they found it occurs most frequently around the tubal orifices.

Schenck[18] found, from microscopic studies of tissue removed from the region of the eustachian orifices in 22 children between six and twelve years of age, a reappearance of lymphocytes six months after irradiation, and a striking increase in the number of lymphatic channels. He felt that the resulting increase in lymphatic flow caused a decrease in edema.

Haines and Harris studied 6149 submariners at the New London submarine base, all of whom were subjected to a pressure test of 50 pounds in from three to ten minutes. Of these, 26.9% developed changes in the middle ear which they graded from 1 to 4 on the basis of apparent middle ear damage as found on examination. In the majority of cases they found: (1) a direct relationship between the amount of lymphoid tissue occluding the eustachian orifice as observed with the nasopharyngoscope and the degree of middle ear damage; (2) 25% of those having perfectly open tubal orifices on examination with the nasopharyngoscope suffered grade 4 damage to the middle ear; (3) 15% with covered tubal orifices had no middle ear damage.

A group of 732 who had failed to pass their pressure tests was treated. Radium applications to the tubal orifices were administered after the technique of Crowe and Burnam.[4] After this treatment, 90% were able to sustain pressure without developing middle ear changes.

In all chronic inflammatory conditions there is a certain amount of lymphoid infiltration. It has been proven by Farrior,[8] and by Fowler,[11] that in some instances this lymphoid tissue is located along the eustachian tube where it interferes with aeration of the middle

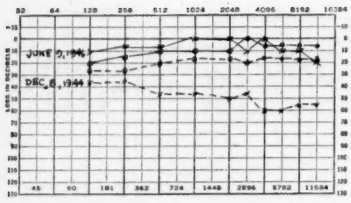

Fig. 3. Case 3.

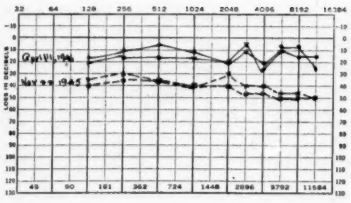

Fig. 4. Case 4.

ear, and in the middle ear itself where it interferes with movement of the ossicular chain.

Fowler[11] in an article on this subject has a table by Quimby which shows that 50 mg. of radium, in a monel metal applicator 0.3 mm. thick, gives practically no effect at 2 cm. distance and no significant effect at a distance of more than 1 cm. with the dosage used. Therefore, this type of irradiation is of no value unless the pathologic changes are located at or near the tubal orifices.

In 1937 we became interested in roentgen treatment for deafness caused by lymphoid tissue obstructing the eustachian orifices, tubes or in the middle ear. At that time we had under treatment a female aged 30, with an obstructive type of deafness. Repeated inflation of the eustachian tubes temporarily improved her hearing. It was apparent she had some obstruction of her eustachian tubes, due to lymphoid infiltration resulting from chronic otitis media which had recently healed following conservative medical management. Following x-ray therapy, her hearing improved and this improvement was maintained.

From 1937 to 1945 we treated 116 private patients with deep roentgen ray therapy for deafness caused by lymphoid tissue obstructing the orifice of the eustachian tube, lymphoid infiltration along the tube proper, or in the middle ear cavity.

Those treated were selected on the following basis:

1. The deafness must have been present longer than three months.

2. Lymphoid tissue could be demonstrated obstructing the orifice of the eustachian tube as observed through a nasopharyngoscope.

3. Those cases in which no lymphoid tissue could be demonstrated obstructing the eustachian orifice were selected for treatment if there was a history of repeated attacks of otitis media, a demonstrable fluid level in the tympanic cavity, or retraction of the tympanic membrane. Several investigators[8, 11] have reported the occurrence of lymphoid infiltration in the tympanic cavity and along the eustachian tube as a result of repeated infection.

4. Cases of chronic otitis media falling into types 1, 2, and 3 (Lillie[14] classification) were selected for treatment. This was done in order to study clinically the effects of irradiation on the hearing as well as the course of the infection. (This phase of the investigation will be reported in detail later.)

The results of treatment were determined by tuning fork tests, ability to hear whispered voice and periodic audiograms in all cases except a few, where the subjects were too young to give a satisfactory audiogram. In those the results were judged on the ability to hear the whispered voice.

Group I (*Age 3-15 years*)— In this age group there were 63 cases. Thirty seven, or 58%, obtained normal hearing after treatment. Twenty and six-tenths per cent of those treated had chronic otitis media (tables I and II).

Group II (*Age 15-62 years*)—This second age group is an interesting one to study. In these cases the pathology is most apt to be in the middle ear or along the eustachian tubes rather than in the nasopharynx or around the tubal orifices. Note that 43.3% in this group had chronic otitis media as compared to 20.6% of those under 15.

Roentgen therapy is the treatment of choice in this group. The amount of irradiation to reach pathology in the middle ear and along the eustachian tube is inadequate with radium in this group.

Techniques.—All patients were treated with the following technical factors: 200 K.V. Peak, 0.5 mm. copper plus 1.0 mm. aluminum filtration, 50 cm. target skin distance, H.V.L. 0.9 mm. copper. Each treatment consisted of a dose of 125 r to 150 r measured in air to each of two ports, one on each side of the face. The ports measured from 4 by 5 cm. to 5 by 6 cm., and were directed to include the middle ear, eustachian tube, and the nasopharynx. Four such treatments were given at weekly intervals.

The average diameter through the head at the level of the ports is 12 cm. in seven-year-old children and 14 cm. in adults. With

TABLE I.

RESULTS OF TREATMENT.

AGE	TOTAL NUMBER	% TOTAL	NORMAL HEARING NO.	%	MARKED IMPROVEMENT NO.	%	SOME IMPROVEMENT NO.	%	FAILURES NO.	%
3-15 years	63	54.3	37	58	8	12	11	17	7	11
15-62 years	53	45.7	9	11.9	17	32	12	22.6	15	28.5

TABLE II.

RESULTS OF TREATMENT.

	CHRONIC OTITIS MEDIA			
	TOTAL		HEALED	
AGE	NO.	%	NO.	%
3-15 years	13	20.6	8	61.5
15-62 years	23	43.3	14	60.9

the factors used and a 20 square cm. port, the dose at 6 cm. and 7 cm. depth are 53% and 44% respectively of the dose in air at the skin. Considering the cross firing principle used, the dose along the course of the eustachian tubes and in the nasopharynx is adequate to benefit chronic infection as well as to reduce lymphoid tissue in size. The dose to the skin and other normal structures irradiated is not enough to cause damage.

An occasional patient gets slight swelling and discomfort in the parotid gland starting a few hours after treatment. This subsides in a few hours. Dryness of the mouth or pharynx has not been noted.

A few case reports showing results of treatment may be of interest:

CASE 1.—A white female, aged 28, was first seen May 21, 1936, complaining of decreased hearing and discharging ears for a number of years. Examination of the ears, nose and throat revealed central perforations in each drum head and a moderate amount of pus

in each middle ear. The rest of the examination was essentially negative. The ear infection was treated medically. When examined on August 20, 1936, each middle ear was dry and the drum heads were healed. The audiogram (Fig. 1) shows her hearing loss on April 10, 1937, when she was started on roentgen therapy according to the previously described technique, and the improvement after treatment.

CASE 2.—A boy, aged 9, was first seen on September 6, 1944, complaining of decreased hearing for the past year. Examination of the ears, nose and throat revealed a small tonsil tag on the right side, lymphoid tissue around each eustachian orifice and a fluid level in each middle ear. He was given roentgen therapy according to the previously described technique, starting on September 12, 1944. The audiogram (Fig. 2) demonstrates the improvement in hearing which followed treatment.

CASE 3.—A patient, aged 27, was first seen on December 8, 1944, complaining of decreased hearing in the left ear for the past year following frequent attacks of otitis media. Examination of the ears, nose and throat was negative except for an old healed perforation in the left drum head. The left middle ear and eustachian tube were treated according to the previously described technique, starting on December 15, 1944. The audiogram (Fig. 3) demonstrates the improvement in hearing.

CASE 4.—A child, aged 6, was first seen on November 22, 1945, complaining of decreased hearing for the past year and frequent attacks of otitis media. Examination of the ears, nose and throat was negative except for retracted, scarred drum heads. The patient's tonsils and adenoids had been removed. The patient was treated according to the previously described technique, starting on November 29, 1945. The audiogram (Fig. 4) demonstrates the improvement in hearing.

SUMMARY

A clinical study of 116 cases of deafness treated by deep roentgen therapy has been presented.

Middle ear changes such as retracted tympanic membrane, the presence of a fluid level in the tympanic cavity, the presence of chronic purulent otitis media, a history of repeated attacks of otitis media, and the presence of demonstrable lymphoid obstruction of the eustachian tubal orifices were the indications for treatment.

CONCLUSION

1. Deep x-ray therapy in the recommended dosage will reduce lymphoid infiltration or hyperplasia at the eustachian orifice, along the tube, or in the middle ear.

2. Deep x-ray therapy is the treatment of choice in these instances where lymphoid infiltration and chronic infection is present in the middle ear and along the eustachian tubes.

3. In no instance have we been able to demonstrate any damage to the surrounding structures as the result of treatment.

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LXXXIII

LOW INCIDENCE OF MASTOIDITIS IN A SERIES OF CASES TREATED WITHOUT SULFONAMIDES

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The inspiration which prompted the work done as the basis of this thesis first came to the writer in the later years of the 1930's. At that time many statistics were presented showing the marked drop in mastoiditis requiring operation since the inception of sulfonamide therapy. Many writers were beginning to feel, too, that chemotherapy had sounded the death knell of otolaryngology as it had been practiced in the past and some even envisaged the passing of their specialty from the field of medicine. McMahon[1] says, "There has actually been an inclination on the part of some otolaryngologists to seek more highly specialized fields within their specialty as a result of the temporary restrictions of their activities supposedly from the use of the sulfonamides and the antibiotics." The sulfonamides were accepted with far more confidence and enthusiasm than during the earlier flurry in chemotherapy in 1919, when mercurochrome was introduced by Young and his associates in Baltimore as an antiseptic for gonococcus, Bacillus coli and staphylococci in the urinary tract, and later advocated by the same author as a germicide in the treatment of septicemia.[2] It is needless to add that it has passed into disrepute. No parallel is to be drawn, certainly, between the two drugs, except that throughout medical history each new discovery has given rise to unfair estimates of its value, and the reputable drugs have finally found their use and outlived their abuse.

So, with the sulfonamides, the thought occurred that perhaps too much was expected of them. They had more than proven their worth in the treatment of pneumonia and other conditions in which the two prime requirements for their success could be met: high blood concentration and high total volume of the drugs with their long-continued presence in the affected area. It was difficult to envisage the meeting of these prime requirements when the anatomy of the middle ear and the mastoid was considered together with the pathological conditions occurring during inflammatory changes. It was necessary to consider also the normal cycles in the incidence of

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sequelae of middle ear infections. It has long been recognized that there are "mastoid years", when a far higher proportion of operative cases may be expected, a notable example being the winter of 1928-29.

A consideration of the anatomy raised the question of whether the beneficial effects of the drug would outweigh the already recognized drawbacks of toxicity and "masking" of danger signals. The arteries supplying the thin mucosa of the tympanum are the tympanic branch of the internal maxillary artery (anterior portion); the middle meningeal branch of the internal maxillary artery which sends a branch to anastomose with the stylomastoid, a branch to the promontory and another to the tensor tympani muscle; the ascending pharyngeal artery which sends branches to the floor and the promontory; and lastly the internal carotid artery in its passage through the carotid canal which gives off branches to the anterior wall of the cavity. The blood supply of the mastoid area is derived from the stylomastoid and the middle meningeal arteries.

All of these vessels are small in caliber, deliver a relatively small amount of blood and are subject to thrombosis.[3] Lederer[4] states that the commonest form of mastoiditis is the thrombophlebitic type characterized by vascular engorgement, thrombosis and round cell infiltration. Stengel and Fox[5] state that the mastoid cells are always somewhat involved in purulent otitis media, the lesion being a mucocatarrhal or a suppurative process upon which membranous or osseous ulceration may supervene. This would indicate that even during primary otitis media there is a certain amount of interference to the blood supply of the mastoid, with consequent diminution in the supply of any arterial-borne drug to the area. Perhaps this actually is of secondary importance, as Wolf[6] states that in his opinion a large percentage of acute infections of the middle ear are self-limiting and will usually respond satisfactorily to the ordinary therapeutic measures. This had not been written at the time of the studies here reported.

During the years just prior to World War II, the author practiced in a small northern city which drew from a large rural area. His own practice had been to treat ear infections conventionally if they were progressing clinically satisfactorily, while that of another otolaryngologist, with excellent training and a comparable volume of both private and ward patients, had been to treat all cases with chemotherapy. It was interesting to note that the number of mastoidectomies done by each was almost identical over a three-year period. Many of the mastoidectomies were upon patients referred

to the hospital from rural areas, where heavy sulfonamide therapy had in most instances been instituted. However, operation proved necessary, sometimes urgent, in those cases in which the previously mentioned well-known masking effects of the drugs had sometimes produced a sense of false security during formation of an epidural abscess.

While much had been published reporting apparent results with sulfonamides, there were no statistics on the results during the same period in cases in which conventional methods had been employed. The clinical material available in the author's city of residence was not sufficient to produce a large number of cases for study, but the advent of the recent war and the author's early entrance and assignment as Chief of the Ear, Nose, and Throat Clinic of a large regional station hospital provided the desired opportunity for studying a large number of controlled cases. The work done and the statistics recorded covered the period from September 1942 through February 1944. The receipt of overseas orders and subsequent foreign duty of the writer prevented earlier presentation of this material.

The regional station hospital in question was opened at a large air force radio school where classes up to 400 in number were admitted weekly. The average stay of each soldier in the school was over four months, while the permanent station complement remained indefinitely during the early years of the war. It was thus possible to keep close check upon cases and to follow them through to completion. Housing and local climatic factors in the midwestern area where the field was located tended to produce a rather high incidence of both upper respiratory infections and virus pneumonia. Housing consisted of theatre-of-operation type barracks, with cement floors, soft coal stoves and minimum cubic air allotment per person. Constant winds carried dust back and forth over the area. These conditions are mentioned since nearly all patients were treated from quarters because of overcrowding of hospital facilities.

The men themselves spent long hours at their radio studies, and a large percentage appeared at one time or another at the Ear, Nose, and Throat Clinic with ear ailments, real or imaginary, the latter caused by subjective symptoms produced by constant use of headsets and the deadly monotony of constantly listening to code delivered at increasing speeds. Parenthetically, it might be stated that a very competent psychiatrist was of great assistance to the otologists in evaluating the complaints. The average daily attend-

ance at the Clinic for ear, nose, and throat affections was 98, seven days each week. Consultations on hospitalized personnel brought the daily number of patients seen to 107.

With the appearance of increasing numbers of ear infections a definite policy was established for treatment, the cases to be studied were classified, and the results tabulated. Only those cases which could reasonably be considered possible of terminating in mastoiditis requiring operation were included. In spite of urging to the contrary by general medical officers, it was agreed with higher authority that all infections involving the tympanic membrane, middle ear and mastoid would be treated conventionally, without the use of sulfonamides, unless and until an alarming number of operative cases occurred or there was an evident persistence of symptoms beyond a reasonable period of convalescence. All patients were to be seen initially by the chief of clinic and uniform treatment given all cases in any classification. These classifications were:

1. Myringitis and myringitis bullosa
2. Secretory or exudative otitis media
3. Acute purulent otitis media
4. Mastoiditis

Aerotitis media as such was not frequently observed in this clinic, and neither this condition nor simple eustachian tube inflammations are included in the study. Only three cases of chronic purulent otitis media were observed and these were not included. Because of the need for keeping men at their classes, all who were afebrile were treated as out-patients. Where headsets produced otalgia, the students were excused from this phase of their work.

Under the classification of myringitis were included all cases in which there was injection of the drum membrane, usually accompanied by considerable pain but without fever, with no demonstrable loss of hearing and no tinnitus. The presence of blebs (myringitis bullosa) did not alter the prescribed treatment. In these cases early treatment of the causative rhinitis and pharyngitis was prescribed. The patients were carefully instructed in the proper technique of blowing the nose, being directed never to close both nostrils at the same time. They were also given explicit directions for the employment of cold water drops in the affected ear as suggested by Tobey,[7] this procedure to be carried out between visits to the clinic. The soldier was instructed to lie down with the affected ear up and to drop five to six drops of the water into the external auditory canal, where the water was to remain five minutes. The

procedure was repeated at two to three-hour intervals until the inflammation of the outer layer of the membrana tympani was found on examination to have disappeared. Neosynephrin drops were also issued for use between treatments by the medical officer, Rose's position being used for the instillation. Of 46 patients observed all but two were relieved of symptoms within two days and had normal drum membranes within one week. Two cases terminated by rupture of the membrana tympani, followed by uncomplicated acute purulent otitis media.

Junior officers were instructed that in cases of acute secretory exudative otitis media there was an actual inflammatory condition within the middle ear, with a collection of fluid which was turbid and contained the elements of inflammation. This was contrasted to the noninflammatory character of the fluid in serous otitis media, which condition was not to be included in the study since it could so seldom be considered liable to assume an inflammatory character. Patients in this group complained of a feeling of fullness or stuffiness of the ear, of slight pain, and of impaired hearing and tinnitus. The subjective sounds were usually described as "gurgling" or "like rushing water." Autophonia and vertigo were additional frequent complaints. Cases were placed in this category if on examination the drum membrane showed diffuse redness and congestion with or without retraction, but no evidence of purulent content in the middle ear. Frequently fluid levels were detected and later the drum membrane often was bulging. There was seldom more than slight elevation of temperature.

In the treatment of these cases, methods were employed as in the first classification and were directed to the reduction of congestion before any attempt was made to catheterize the eustachian orifice and inflate the middle ear cavity. After two to three days of preliminary treatment gentle inflation was instituted which seemed to dissipate the accumulated fluid in the middle ear. Only when the membrana tympani showed definite bulging with rupture imminent was a myringotomy performed at once; later in eight cases in which the infection proved rather stubborn incision was carried out with rapid progress following. Since this work was done, Eagle[8] has advocated routine myringotomy in the treatment of this condition. Of 103 cases, five progressed to acute purulent otitis media terminating uneventfully. In all other cases normal hearing was recovered and the patients were discharged in from five days to two weeks.

Patients appearing at the clinic with the classical symptoms of pain, injection and bulging of the drum membrane, fever and marked loss of hearing were placed in the classification of acute purulent otitis media. Early myringotomy, as advocated by Dench,[9] was practiced and the patient instructed in the use of the ear syringe, a fellow soldier being depended upon to irrigate the ear with warm boric acid solution, at least four times daily. If fever persisted on the following day, the patient was admitted to the hospital for treatment. Otherwise he was cared for as an out-patient, because of the heavy demand for hospital beds arising from other illnesses. It is regretted that bacteriological studies can not be presented, but, again, because of over-loading of the laboratory facilities, routine examinations of purulent discharge could not be carried out. Daily attendance at the Clinic was required until the discharge stopped. The ear was carefully cleared of any debris left from the syringing and 70% alcohol was instilled on a cotton applicator. Attention was given to the usually accompanying rhinitis and neosynephrin nose drops were given in all cases. Of 461 cases of acute purulent otitis media, mastoiditis developed in two of them and operations were necessary. X-ray studies were made in 200 cases and in nearly all there was some evidence of inflammatory reaction in the mastoid region. In only two cases, however, did subsequent roentgenograms show failure of the process to completely resolve. Six patients were transferred from the field before the ear canals were wholly dry. The period of convalescence varied from four days to six weeks, the average time required for return to normal, with unimpaired hearing, being two and one-half weeks.

Of the cases in the mastoiditis classification, two patients developed this following purulent otitis media which had been cared for in the home clinic and surgery was necessary. Two patients with acute mastoiditis were admitted directly to the hospital when first seen in the Out-Patient Department. One of the latter was a recent arrival from civilian life on whom there was no record of treatment. The other was a soldier transferred from another post, whose record revealed that he had had treatment with sulfonamides for acute purulent otitis media and mastoiditis, with apparent subsidence of symptoms. When first seen his temperature was 105° F. and there was postauricular edema upon the affected side. X-ray films showed complete cellular destruction of the left mastoid area and an immediate operation confirmed this finding and also revealed an epidural abscess. Simple mastoidectomy was performed upon this patient and the other three with uncomplicated mastoid-

itis, with uneventful recoveries. All were given sulfonamides postoperatively.

SUMMARY

The similarity in results obtained both by conventional therapy and by sulfonamide therapy observed by the author in cases of ear infections prior to World War II inspired the studies reported. A consideration of the modus operandi of sulfonamide drugs and the anatomy of the area involved gave further indication that perhaps there had been over-emphasis upon the value of sulfonamide therapy in otitis media and associated conditions. The series of cases reported were taken from an army clinic where men were not treated ideally but as dictated by the exigencies of the situation; due consideration, however, was given to their progress and unnecessary risks were studiously avoided. In a series of 610 cases of myringitis, exudative otitis media and purulent otitis media, there were two mastoidectomies, with two additional from sources outside the study. If only the 461 cases of purulent otitis media are considered in relation to the two mastoidectomies, it would seem that the morbidity of ear infections in recent years has parallelled the known decrease in morbidity of such conditions as measles and scarlet fever and that this, rather than the advent of the sulfonamides, accounts for the very happy outcome of the average ear infection.

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LXXXIV

STREPTOMYCIN TOXICITY TO THE LABYRINTH

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Some 900 cases of tuberculosis treated with streptomycin at Fitzsimons General Hospital in connection with the Army, Navy and Veterans' Administration project for streptomycin therapy evaluation have been the subject of comprehensive and combined reports of these services.[1, 2] In this general group, certain clinical observations as to incidence and symptomatology of neurotoxic effects of streptomycin have been made. Two selected groups of approximately 50 patients each have been observed specifically for physiologic labyrinthine function. The first group on which labyrinthine testing was done consisted of patients on 3 gm. and 2 gm. per day dosage of streptomycin during varying phases of treatment. The second group was limited to those on 1 gm. of streptomycin per day in whom labyrinthine studies were carried out prior to, and at weekly intervals during, the whole course of treatment. Audiometric recordings have been made routinely on the majority of streptomycin-treated tuberculous patients of the hospital.

Observations specifically directed to evaluation of the neurotoxic effect of streptomycin on the labyrinth have been reported particularly by Hinshaw and Brown,[3] Fowler and Seligman,[4] Farrington and Hull-Smith,[5] Glorig and Fowler,[6] Tompsett,[7] Snell,[8] and from this hospital.[9]

Our clinical experience indicates that the incidence of labyrinthine dysfunction bears direct relation to dosage and duration of streptomycin treatment. In approximation, labyrinthine dysfunction will appear in the fourth to the sixth week in 90% of patients receiving 2 gm. per day, while the incidence on 1 gm. per day dosage is 4% of relatively severe symptomatic labyrinthine depression and 24% of milder reactions. Both the severe and milder reactions of the lower dosage group tend to occur after the same interval of time on treatment or slightly later. Tompsett[7] has directed

attention to the need for evaluation of dosage in terms of body weight for prediction of the dosage at which labyrinthine effect may be anticipated.

Hinshaw and Brown,[3] Farrington and Hull-Smith,[5] and Fowler and Seligman[4] have recorded auditory loss in association with streptomycin therapy. Reported cases appear to be limited to patients receiving the higher dosage of 3 gm. and those with tuberculous meningitis. Our general audiometric studies give the impression that 2 gm. and 1 gm. dosages per day are without auditory sequelae. In particular, audiometric evaluations of both selected groups of patients have not shown significant hearing loss. One case of tuberculous meningitis presented marked auditory and labyrinthine loss, nystagmus, disordered optokinetic response, and other neurologic signs indicative of widespread central nervous system damage.

In assessing the nature of vestibular dysfunction encountered in patients under study, attention has been directed to the following:

a. Subjective nature of the vertigo.
b. General neurological evaluation.
c. Evidence of ocular imbalance or abnormal optokinetic function.
d. Labyrinthine testing.
    1. Caloric tests.
    2. Galvanic response tests.

The subjective nature of the vertigo has been adequately defined by Hinshaw and Brown[3] and Glorig and Fowler[6] as previously cited, as well as by later authors. It is not described by the patient as a true turning vertigo. With a few exceptional cases to be discussed later, it appears unassociated with spontaneous nystagmus or directional tendencies in falling. Ordinarily, the vertigo is one elicited by motion, such as arising from bed, turning in bed, or going around corners. Particularly unpleasant is a sudden turning in a wheel chair. Disability is pronounced in walking at night. As in other labyrinthine disease, recovery appears to proceed by adaptation of equilibrium to the remaining proprioceptive and ocular components of the equilibrial triad of visual, proprioceptive and labyrinthine orientation. This proceeds in the absence of evidence of labyrinthine recovery by physiologic testing. As noted by Glorig and Fowler,[6] the older patient recovers from loss of equilibrium and vertigo poorly. In the 20 to 30 year age group, little disability is obvious after six months to one year. The Romberg returns to normal and walking is accomplished in the dark without a cane. Such patients still complain of difficulty in driving a car over bumpy roads or

executing sudden turns. Alcohol, particularly, is poorly tolerated as regards equilibrial stability. A permanent partial disability is to be anticipated in many cases. The remarkable readjustment of equilibrium attained by our younger patients is rendered more comprehensible when the congenital deaf mute is considered. The deaf mute, who is without labyrinthine function by physiologic testing, has long been known to adapt so well in childhood that almost no equilibrial disability is evident on simple observation.

Where cases of tuberculosis of the brain or meninges are eliminated, general neurologic evaluation of the streptomycin treated case fails to demonstrate focal neurologic findings other than those referable to vestibular dysfunction. The patient presents a major asynergia and obvious equilibrial disturbance resembling some of the lesions of the flocculo-nodular area of the cerebellum. In a recent article, Lindsay[10] refers to the vertigo associated with streptomycin toxicity as a positional vertigo of central type. In previous clinical experience with labyrinthine disease, the essentially postural nature of streptomycin induced vertigo, the dissociation of vertigo and nystagmus, as well as the absence of acoustic changes, would clearly indicate labyrinthine disease of central origin. However, the cases in which Dandy[11] sectioned both labyrinthine nerves for Ménère's disease suggest by similarity of symptoms that this equilibrial disorder may be of a peripheral nature. Reports of pathological studies of the peripheral labyrinth and brain stem are not available at this writing.

Associated with the vertigo are frequent complaints of difficulty in reading. For this reason, a group of 50 patients with varying degrees of vertigo were subjected to optokinetic nystagmus testing, eye muscle balance test, fusion, visual acuity, accommodation test, and observation for spontaneous nystagmus. Abnormalities were not detected although the complaint of vertigo with reading is quite real. It appears related to the discomfort associated with removal of ocular fixation on the surroundings from an equilibrium already distressed by loss of labyrinthine function.

Specific labyrinthine testing consisting of caloric and galvanic tests has been conducted. The caloric test utilized has been Atkinson's modification of the Kobrac test further adapted to bed and ambulatory patients by reading the nystagmus time with the head turned back to optimal position. A ratio of 1:1 or 1:2 of latent period to nystagmus time is associated with marked clinical loss of vestibular reactions. Clinical testing beyond the use of 1 cc. of ice water for one minute has not been done in this clinic. In our hands,

greater stimuli appear to be beyond the physiological competence of the labyrinth and inaccurate for clinical purposes. Therefore, routine testing beyond the amount and duration of this stimulus has not been done.

Galvanic testing is accomplished by recording the tipping reaction of the patient on a balance board with the anode applied to the region of the mastoid and the cathode held in the hand of the patient. The majority of individuals tip at one to two milliamperes by this procedure. Less than four milliamperes is considered within normal limits. Approximately 10% of all individuals tested do not respond to galvanic current. This is thought to be due to the configuration of the head and the consequent path of the electrical current. The galvanic response is utilized with a view to determine whether or not the vestibular nerve is intact in the presence of peripheral sensory loss of vestibular function.

Physiologic labyrinthine studies were made on the two separate categories of patients. In the first group of 50 patients, streptomycin dosages consisted primarily of 2 gm. per day with a few receiving 3 gm. per day for varying intervals of time. In some instances studies were undertaken while the patient was on his second or third course, or at intervals of several weeks following his course of streptomycin. The second group consisted of 50 patients newly selected for 1 gm. per day dosage to extend over periods of six to twelve weeks. This group received weekly labyrinthine tests preceding treatment and continuing throughout the treatment. Subsequent studies were made on cases showing neurotoxic effects up to 20 weeks after therapy was discontinued. The main objective in the labyrinthine studies conducted on the latter group was the determination of the incidence of streptomycin effect under the prescribed dosage. The incidence and severity of vestibular symptoms in this group may be summarized as follows:

a. No vertigo or vestibular defect on testing—36 patients (72%).

b. Mild vertigo and mild vestibular dysfunction on testing—3 patients (6%).

c. Marked vertigo and marked vestibular dysfunction on testing—2 patients (4%).

d. No vertigo with mild vestibular dysfunction on testing—9 patients (18%).

As previously noted these defects appear after approximately one

month of therapy. These findings represent a somewhat lower incidence of toxicity as regards severer reactions than reported by the Veterans' Administration at the Conference of the Veterans' Administration, Army and Navy Study Units, held in Chicago, Illinois, April 15, 1948. Some four or five patients who complained of vertigo without physiologic evidence of vestibular hypofunction have not been included in this series. We assume that the element of suggestion was operative in this group.

Considering the entire study, certain observations of interest as to the nature of the neurotoxic effect of streptomycin may be noted.

In the higher dosage group, evidence of vestibular suppression by physiologic testing was not found to precede subjective vertigo or Romberg instability. In the lower dosage group, as noted above, there were nine instances in which vestibular depression was unaccompanied by vertigo, or in which it actually preceded vertigo. This appears compatible with the milder toxicity effect of the lower dosage and demonstrates capacity for adaptation where vestibular suppression proceeds slowly. This adaptation, while apparently complete in most instances in the sedentary surroundings of hospital, has manifested itself as symptomatic vertigo in at least two instances. In these cases, patients leaving the hospital on pass complained of vertigo on riding busses or driving cars. Contrasting with this evidence of adaptation during vestibular depression and illuminating the relationship of vertigo to vestibular depression are five cases immobilized in orthopedic appliances while receiving 2 gm. of streptomycin per day. These patients gave no complaint of vertigo when first seen, but demonstrated no response to caloric testing of the labyrinth. In some instances similar cases have subsequently "discovered" their vertigo when turned over in orthopedic appliances, or when they became ambulatory. It would appear that there had been a symmetrical depression of vestibular sensibility, which was nonsymptomatic until failure of vestibular response, in the presence of motion, aroused vertigo at a later date.

In most instances, patients who demonstrated a loss of vestibular response to 1 cc. of ice water for one minute experienced no further vertigo on retreatment. Where residual vestibular function was demonstrated, vertigo did recur, usually to a lesser extent than on previous treatment. This also tends to confirm the nature of the toxicity as one of suppression of function without arousal of irritative phenomena.

All but 7 of 59 patients developed symmetrical depression of the labyrinth, instability of the Romberg, and unsteadiness on walking with the eyes closed, with no directional falling, past pointing or nystagmus. In one case a true labyrinthitis appeared as a toxic manifestation. This case demonstrated nystagmus, directional falling tendencies, and labyrinthine imbalance on physiologic testing on the fifth day of treatment with 2 gm. per day dosage. On cessation of treatment, he made a complete asymptomatic recovery with return of labyrinthine tests to normal after one month. Among the other patients who displayed differences of 10 to 15 seconds in caloric reaction time between the two ears or who showed inequalities of rate or amplitude of nystagmus, it appeared that symptoms were of earlier onset and greater severity. In four instances there was a tendency to deviate in walking with the eyes closed and to past point symmetrically with both arms. In no instance could a change of direction of falling be demonstrated by change of head position. Within two or three weeks, directional tendencies were lost and labyrinths were symmetrically depressed. Thus the majority of patients demonstrated an essentially symmetrical toxicity effect between the two labyrinths.

Certain variations in galvanic and caloric effects are noteworthy. In the larger dosage group of 50 cases, 24 instances of a normal galvanic response in the presence of impaired caloric reaction were encountered. These cases represented from 14 to 60 days of treatment at 2 gm. of streptomycin per day. In 17 of the 24 cases, galvanic response was retained throughout treatment although caloric loss was either retained or progressed. In seven instances, galvanic loss followed caloric loss at two to four week intervals. Among patients who had more severe reactions, history of previous streptomycin therapy with reaction, or long-continued dosage, galvanic response was absent with severe caloric depression at the time of initial testing. There were, however, three instances of galvanic recovery without evidence of caloric recovery after treatment was discontinued. An additional five cases were of interest in that asymmetrical depression of the caloric reaction was attended by normal galvanic responses. In two of these cases, the galvanic tests became asymmetrical approximately two weeks after the caloric imbalance, and subsequently progressed to symmetrical depression with the caloric reaction. There was no change in the galvanic response in the other three cases. Within the limits of accuracy of galvanic testing, these cases seem to illustrate a tendency for the loss of caloric response to precede the loss of galvanic response in a manner which

suggests initial peripheral labyrinthine changes succeeded by subsequent deterioration of the vestibular nerve.

Recovery of labyrinthine function as demonstrated by physiologic testing contrasts with the clinical recovery manifested by adaptation. Until recently we had concluded that there was no recovery of labyrinthine function after any appreciable degree of depression had been demonstrated by physiologic testing. There is one instance, however, of partial recovery after approximately six months among the group of patients receiving 2 gm. per day of streptomycin with consequent severe labyrinthine depression. Approximately 25 other patients of this group who had suffered labyrinthine loss eight to 18 months previously have been available for testing with no other example of recovery. In the 1 gm. per day dosage group, however, eight cases of mild caloric depression returned to previous levels within six to eight weeks. Also in this group, one of two cases of severe caloric depression returned to normal levels. This represents 64% incidence of recovery in this group.

SUMMARY

A group of streptomycin-treated tuberculosis cases have been reviewed for evaluation of the incidence and nature of streptomycin toxicity. The following findings are presented:

1. While the 2 and 3 gm. dosages of streptomycin per day produced vestibular toxicity in almost all cases treated for one month or more, the 1 gm. per day dosage produced a low incidence of toxicity (only 4% of any degree of severity) in a similar period of time. The neurotoxic effect on the labyrinth produced by the lower dosage appears more gradually and has been demonstrated as reversible in some cases by physiologic testing.

2. Vestibular depression as a result of streptomycin toxicity is symmetrical between the two labyrinths and without irritative phenomena in the form of hyperirritable labyrinthine response or acute imbalance.

3. While the nature of the vertigo produced by streptomycin toxicity resembles that attributable to central disease in previous clinical experience, uniform symmetrical depression of both labyrinths peripherally may account for the vertigo observed. Variations in galvanic and caloric vestibular testing results may suggest peripheral labyrinthine dysfunction as a manifestation of streptomycin toxicity for the labyrinth.

4. Changes in the auditory function of the eighth nerve have not been observed on 2 gm. and 1 gm. per day dosage of streptomycin in the absence of other neurologic disease.

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LXXXV

OBSERVATIONS ON SURGICAL ANATOMY IN THE FENESTRATION OPERATION

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A close study of the anatomical structures, their relations and variations in large numbers of cadaver specimens will not only insure success of the fenestration operation today but will also form the basis of improved techniques tomorrow. A preconceived, standard and inflexible surgical procedure will not work in all cases. Each case reveals individual anatomical differences.

In the performance of 400 fenestration operations on fresh adult cadavers, intimate knowledge was gained concerning variable anatomical structures and their relations. During the process of the above cadaver work almost all of the errors in technique were made and repeated, sometimes deliberately. Thus were learned the dangers of the operation and how to avoid them.[1] This report includes some anatomical observations and measurements made during the course of these cadaver operations. Measurements were made with a 10 X optical loupe.

Approach to the Mastoid Antrum.—The long, serrated perforating bur was used to penetrate the mastoid from the outer cortex to the lower portion of the mastoid antrum; the point of entry in the cortex was about 7 mm. below the junction of the superior and the posterior bony canal walls and 3-5 mm. behind the posterior canal wall (Fig. 1). The direction of the perforating bur is perpendicularly inward and slightly forward. In no case was the sinus or the dura injured in this series of 400 mastoids, many of which were small and sclerosed.

As the bur enters the antrum, one gets the feel of the bur suddenly entering a dead space. The perforating bur is then withdrawn. In 200 consecutive penetrations of the mastoid, the bur could be distinctly felt entering the dead space of the mastoid antrum 120 times; whereas, in the remaining 80 cadavers the "feel"

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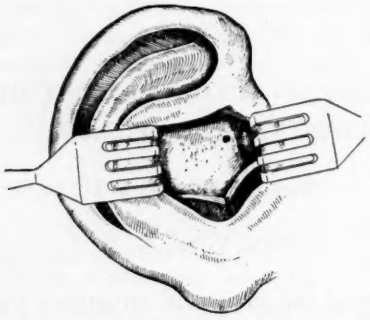


Fig. 1.—Drawing showing point of entrance of perforating bur through the mastoid cortex—about 7 mm. below the junction of the superoposterior canal walls and 3-4 mm. behind the posterior canal wall.

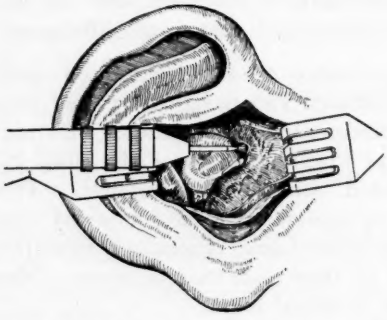


Fig. 2.—Appropriate sized, round cutting burs instead of curettes are used to thin the bony external canal walls and to expose the entire short process of the incus, until a space 1 mm. wide anterior to the short process of the incus is seen leading into the tympanum.

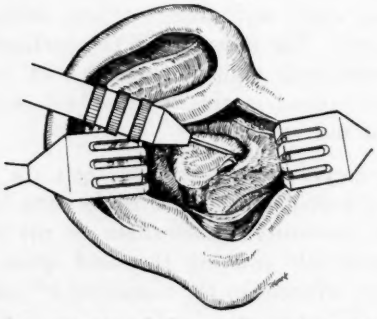


Fig. 3.—Further exposure of the ossicles and creation of the space anterior to the head and neck of the malleus are achieved by the use of appropriate sized, round cutting burs.

TABLE I.

DISTANCE FROM MASTOID CORTEX TO BOTTOM OF ANTRUM

Distance in MM.	Number of Cases
13	56
16	136
20	8
Total	200

Average Distance 15.3 mm.

of entering the antral space was indistinct or absent. In these latter cases there was uncertainty whether the end of the bur had passed the antrum (dangerous) or had not yet reached it. To help resolve this uncertainty the distance was measured from the outer mastoid cortex along the path of the perforating bur to the bottom of the antral space. This distance was compared to the length of the cutting edge of the perforating bur (12 mm.). The results are shown in Table I.

In all of the 200 cases the bottom of the antrum was deeper than the length of the cutting surface of the bur: the difference being 1 mm. in 56 cases; 4 mm. in 136 cases; and 8 mm. in 8 cases. One can, therefore, be quite certain of the relation of the point of the bur to the antral space, especially when the entering can not be felt distinctly.

In sclerosed mastoids where the bone is dense throughout, the above measurements insure safety in entering the mastoid antrum.

Exposure and Relations of the Short Process of the Incus.— After the posterior bony canal wall is thinned out, a portion of the short process of the incus is brought into view. The canal wall just anterior to the entire length of the short process of the incus is shaved again and again until a distinct space about 1 mm. wide is created between the incus and the adjacent bony canal. Through this space one looks directly into the tympanum (Fig. 2). This space at the lowest limit of the short process of the incus may be as much as 2 mm. The final bridge of bony canal can then be easily removed in toto with the pointed, straight rongeur and measures about 1-1.5 mm. in thickness. In this manner the thinnest portion

of the membranous canal is kept free from injury and adherent fractured bony chips.

Space Anterior to the Head and Neck of the Malleus.—The distance from the anterior aspect of the head and neck of the malleus to the anterior wall of the tympanum is 5-7 mm. It is desirable to create a space 2 mm. wide anterior to the head and neck of the malleus, just above the anterior malleolar ligament (Fig. 3). The creation of this 2-mm. space suffices to insure the engagement of the head and neck of the malleus in the jaws of the nippers. The natural space between the posterior surface of the head of the malleus and the inner wall of the epitympanum (2 mm.) together with the artificially created 2-mm. space allows freedom of manipulation.

The artifical 2-mm. space created anterior to the head and neck of the malleus together with the natural 2-mm. space between the head of the malleus and the internal wall of the epitympanum provides enough room for amputation through the neck of the malleus without tearing the drum membrane. In 50 amputations through the neck of the malleus, a deliberate attempt was made to fracture the drum by a to-and-fro rocking motion while the malleus neck was firmly engaged in the jaws of the nippers. In no case was the drum torn.

Relation of Fenestra to the Facial Nerve.—The creation of the fenestra is begun anteriorly 1 mm. from the facial nerve (not closer) and proceeds downward and posteriorly so that the lower end of the fenestra is about 2 mm. from the facial nerve. The relationship of the anterior and posterior ends of the fenestra to the facial nerve is shown in Table II.

One of the hazards is injury to the facial nerve during the creation of the fenestra. This can be avoided by fenestrating *away* from and not toward the facial nerve. Accordingly, the fenestra is begun anteriorly 1 mm. from the facial nerve. As the fenestra is lengthened, the distance from the nerve is increased. When the fenestra is completed (3 mm. in length), the distance from its posterior end to the facial nerve is 2 mm. (Fig. 4).

Inasmuch as the relation of the horizontal semicircular canal to the facial nerve is constant, the measurements in Table II aid in creating a constant position for the fenestra. Occasionally, in a sclerosed bone the limits of the horizontal semicircular canal cannot be definitely identified; whereas the facial nerve is obvious. Therefore, this precise distance between the fenestra and the facial nerve

TABLE II.

RELATION OF FENESTRA NOV-OVALIS TO FACIAL NERVE

Distance in MM.	Upper Limit of Fenestra to Facial Nerve Number of Cases	Lower Limit of Fenestra to Facial Nerve Number of Cases
1.0	110	
1.1	10	
1.2	58	
1.3	2	4
1.4	6	8
1.5	14	8
1.6	....	24
1.7	....	2
1.8	....	54
2.0	....	86
2.2	....	10
2.4	....	4
Total	200	200
Average Distance	1.1 mm.	1.9 mm.

insures both the integrity of the facial nerve and the proper position of the fenestra at the same time.

Size of the Fenestra Nov-Ovalis.—After the fenestra nov-ovalis was made of adequate size, it was measured either in situ or after removal. The results are shown in Table III.

The size of the fenestrae in this series of 200 is different from that reported by Lempert[2] (5 mm. long and 2 mm. wide.) In only 28 cases in this series was the length of the fenestra between 3.1 and 3.8 mm.; whereas, in 172 of the cases the length of the fenestra was 3 mm. or slightly less. In none of the cases was the fenestra wider than 1.3 mm.

In creating the "blue line" in the bony labyrinth as described in the standard technique, there is some tendency to produce a very narrow fenestra by prematurely opening the perilymph space at some point along the blue line. Once a too narrow fenestra has been created and the membranous labyrinth exposed, any further attempt to widen the fenestra is accompanied by the danger of injury to the delicate labyrinth. It is technically no more difficult to insure a wide fenestra by creating a wide "blue area" (ultimate size of

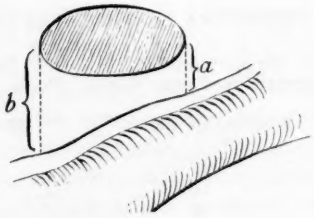


Fig. 4.—Drawing showing relation of fenestra to facial nerve. a—1 mm. b—2 mm. Beginning the fenestra anteriorly 1 mm. from the facial nerve and ending posteriorly 2 mm. from the facial nerve insures integrity of the facial nerve and proper position of the fenestra.

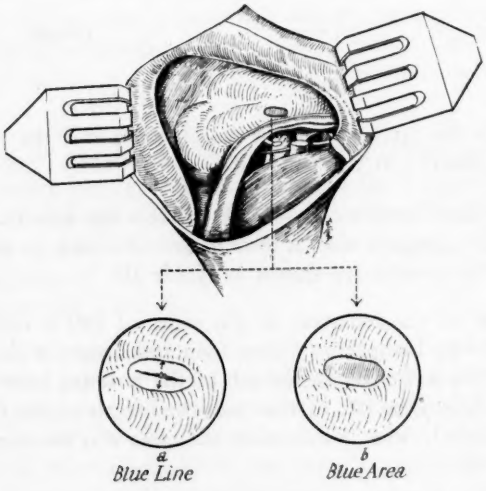


Fig. 5.—*a* "Blue Line" created over the fenestra in standard technique. *b* "Blue Area" suggested in this technique insures a wider fenestra and less manipulation in removing the endosteum from the fenestra and its walls.

TABLE III.

SIZE OF FENESTRA NOV-OVALIS

In MM.	Length of Fenestra Number of Cases	Width of Fenestra Number of Cases
1.0	....	132
1.1	....	38
1.2	....	24
1.3	....	6
2.5	4	....
2.8	2	....
3.0	166	....
3.1	22	....
3.4	2	....
3.5	2	....
3.8	2	....
Total	200	200
Average	3 mm.	1 mm.

fenestra) instead of a narrow "blue line." This technique of creating a large "blue area" was employed in this series of 200 cases (Fig. 5).

Shrapnell's Membrane in Relation to the Fenestra.—A study of the relationship of Shrapnell's membrane to the fenestra was made after the operation was completed and the tympanomeatal membrane was properly placed over the fenestra.

A puncture wound was then made through the flap into the fenestra in 50 cases and the distance from the short process to the fenestral puncture in the flap was measured. Similarly, a puncture through the upper limit of Shrapnell's membrane was made and the distance from the short process to the puncture through Shrapnell's membrane was measured. The results are shown in Table IV.

The average distance from the short process to the upper limit of Shrapnell's membrane was 1.8 mm.; whereas, the average distance from the short process to the fenestra was 5.7 mm. Shrapnell's membrane could not be made to reach the fenestra in any of the 50 cadavers operated upon. Skin alone and not mucosa covers the fenestra (Figs. 6 and 7).

Exenteration of the mastoid is carried out with sharp, round cutting burs of appropriate size. Circular shaped cutting burs were used exclusively because they are adaptable to all sizes of mastoid

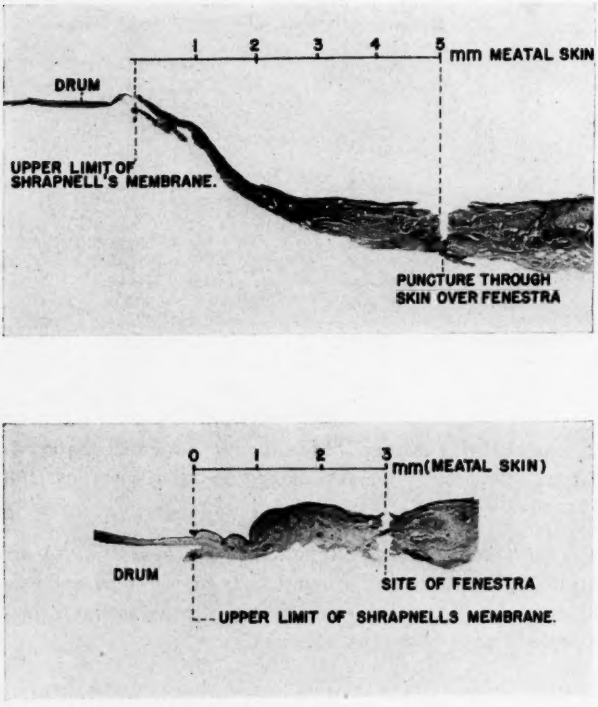

1 2 3 4 5 mm MEATAL SKIN
DRUM
UPPER LIMIT OF SHRAPNELL'S MEMBRANE.
PUNCTURE THROUGH SKIN OVER FENESTRA
0 1 2 3 mm(MEATAL SKIN)
DRUM
SITE OF FENESTRA
UPPER LIMIT OF SHRAPNELLS MEMBRANE.

Fig. 6.—Histological sections showing fenestral puncture wound described in the text and illustrating the distance between the upper limit of Shrapnell's membrane and the fenestral puncture.

TABLE IV.

COMPARATIVE DISTANCE FROM SHORT PROCESS OF MALLEUS TO UPPER LIMIT OF SHRAPNELL'S MEMBRANE, AND FROM SHORT PROCESS TO FENESTRA NOV-OVALIS IN FENESTRATED FRESH CADAVERS.

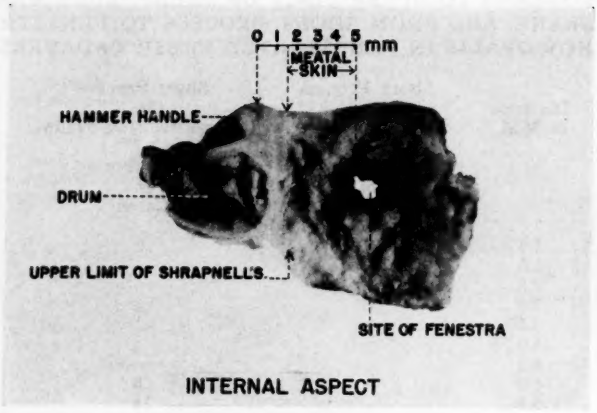
Distance in MM.	Short Process to Shrapnell's Number of Cases	Short Process to Fenestra Nov-ovalis Number of Cases
1.5	10	....
2.0	12	....
2.5	3	....
3.0	....	....
3.5	....	....
4.0	....	....
4.5	....	....
5.0	....	8
5.5	....	14
6.0	....	26
6.5+	....	2
Total	25	50
Average Distance	1.8 mm.	5.7 mm.

cavities, especially small contracted mastoids. Skeletonizing the bony labyrinth was accomplished with curettes.

When working very near an exposure of dura or sinus the bur was abandoned in favor of the curette, because there is a tendency for the bur to find the defect in the bony plate with injury to the dura or the sinus. This accident happens despite conscious efforts to avoid it.

Proper sized burs were used in exposing the entire short process of the incus, the incudo-malleal joint and the 2-mm. space anterior to the anterior aspect of the head and neck of the malleus. Also, burs were used to thin the posterior and superior canal walls. The motor-driven bur was found safer than the curette in the above manipulations.

The careful analysis of operative techniques employed in large numbers of cases brings to the surgeon not only a more facile and perfected skill but a more mature and more confident approach to



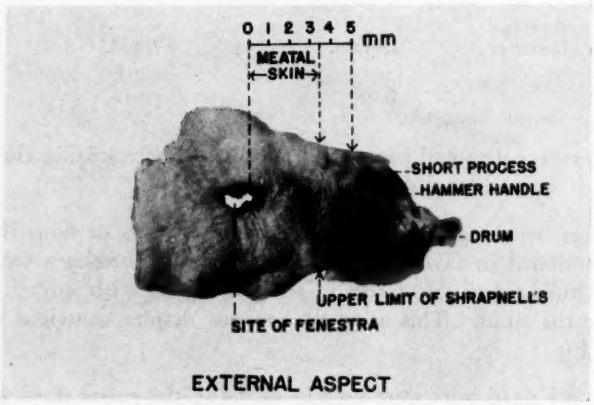


Fig. 7.—Photographs of the inner and outer surfaces of the tympanomeatal flap, demonstrating the distance between the upper limit of Shrapnell's membrane and the fenestral puncture.

each anatomical problem. Fenestration is still in the process of development. With careful work and attentive curiosity, our skills can be improved, our knowledge of the problems can be deepened, and our operative results can be enhanced.

101 EAST 73RD STREET.

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LXXXVI

THE PRESENT STATUS OF OBJECTIVE HEARING TESTS

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The difficulties of obtaining a good determination and a clear graphic portrayal of hearing are manifold. It has been pointed out many times[1] that the state of attention, fatigue, distraction, anxiety and interest influence deeply the performance of the patient in audiometric testing. Hearing is both a physical and a psychological process. Not only must the peripheral sense organ be functioning, not only must the nervous pathways be intact, but a satisfactory psychological attitude toward the hearing test must exist in order that the sensory experience be perceived and utilized.

This short enumeration of factors will show that the method of testing hearing by inquiring about subjective sensations is full of potential errors. Therefore, it would be gratifying indeed if one could replace, or at least amend, the subjective hearing test by objective determination of ear function.

The attempts to determine the function of the ear by objective methods have been numerous.

At the present time, there is no electrical method advanced enough to be utilized for objective hearing tests. The cochlear microphonics have been demonstrated in man by a few authors. However, the difficulties of method most recently outlined by Wever[2] have not been solved as yet.

A considerable number of reflexes have been described but none has the simplicity and reliability to make possible a general application as a routine clinical test.

The following reflexes have been used for the demonstration of cochlear function. First, the acoustic pupillary reflex, secondly, the general muscle reflex, and thirdly, the acoustic lid reflex.

By the very nature of the reflex phenomena their applicability is so limited that they can be used only for the proof of presence or absence of cochlear function. No objective quantitative tests are

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possible. The value of these reflexes is further limited by the fact that negative findings are not definite proof of deafness.

The acoustic pupillary reflex was first described by Holmgren[3] in 1876. This reflex consists in changes of the diameter of the pupil. When a tone is sounded, a small contraction of the pupil is observed. Following the contraction there is a slow pupillary dilatation. The best results with the acoustic pupillary reflex are obtained by short, strong sounds. There are individual differences as to the activity of the reflex. Neurasthenic persons seem to show a brisker reflex. The patellar reflex is a guide to the general tendency of reflexes. The literature shows that even under most favorable conditions the reflex is visible only in 33 per cent of persons with normal hearing. In deafness, even in severe losses of hearing, the reflex can be found, provided loud enough stimuli are used. Complete deafness, however, results in complete absence of the reflex.

The general acoustic muscle reflex is a contraction of various body muscles in response to loud, unexpected or terrifying sounds. In man it is a remnant of the "fear-reflex", generally found in animals. In man there are responses to tone which are either movements of the head only, of single muscle groups or of the whole body. The best subject for observing the general muscle reflex is the infant. A typical reaction of the infant to sound consists in movement of the head, contractions of the rump muscles and extension of the arms. The special sensitivity of this reflex in the infant diminishes during the first years of life and equals that of the adult when the age of three or four years is reached. The general muscle reflex is not a reflex in the strictest sense. Surprise and fear have a definite influence in the adult. Once the individual is accustomed to the sound stimulus, the reflex becomes diminished or even abolished. The reflex is not easily used for tests on malingering because voluntary inhibition is possible. However, when a very complicated method is used, in which reactions of several muscle groups of the body are recorded by ink-writing, successful tests are possible and proof of malingering is obtained.[4] Quantitative measurements are not possible with the reflex method. No true relation between stimulus and response has been observed: the cochlea is either dead and the reflex absent, or there is function and a response is obtainable. In cases of partial function even in severe deafness a strong, brisk reflex can be elicited occasionally if the stimulus is strong enough.

From a study of the literature it becomes apparent that this general muscle reflex is still widely used for determination of function in infants. The Ewings[5] have utilized the jerking of the head,

twitching of the fingers and other muscular responses in their work on children. Froeschels[6, 7] observed the blinking of the lid as well as grimaces of the whole face.

Practically, the most important acoustic muscle reflex is the cochleopalpebral reflex. It is, in reality, a part of the general muscle reflex but it deserves special attention and special treatment because it has the lowest threshold of all acoustic muscular reflexes. It has been found in 90-95 per cent of normal adults. Like the other acoustic muscle reflexes it is subject to voluntary cortical inhibition; therefore, the sound stimulus should be given as a surprise. Short, sudden, shrill sounds are the most favorable stimuli. Higher frequencies between 2000 and 4000 c.p.s. give the most constant results. Tactile sensations must be avoided; that is, the tone must not be conducted into the outer ear by tubing, nor should the Bárány noise box be inserted into the ear canal. It has been proven that completely deaf persons have a lid reflex under these conditions, while none could be elicited when the tone was given from a distance.

Our own experimental work on the middle ear muscle reflex of animals and its physiological effect on hearing lead naturally to an examination of the stapedius or tensor reflex in man. The difficulty of the method consists in the hidden position of the muscles. While the pupil reflex can be observed with the greatest of ease, the intrinsic ear muscles are hidden behind the ear drum. We had learned from the animal experiment that the ear drum appears immobile to ordinary observation in spite of the fact that the muscles inside the middle ear are actively contracting to sound. This contradicts the old argument that the intrinsic muscles of the human ear are inactive because the ear drum does not show any visible movement. In pathological cases, when there is a perforation in the posterior superior quadrant, the stapedius tendon is visible. The first observation of the stapedius reflex in man was made by Luescher.[8] Our own clinical observations have shown that an active stapedius reflex is not a rare occurrence and that it may frequently be demonstrated during a routine examination.

The method is very simple. Slight magnification as provided by a Siegle speculum is an advantage. Since the reflex can be elicited in either ear, sound can be conducted either into the ipsilateral or into the opposite ear. By observing the stapedius tendon the contractions of the stapedius muscle are shown to last exactly as long as the duration of the sound. There is a brisk onset and a slightly less quick return to the relaxed state when the tone is terminated.

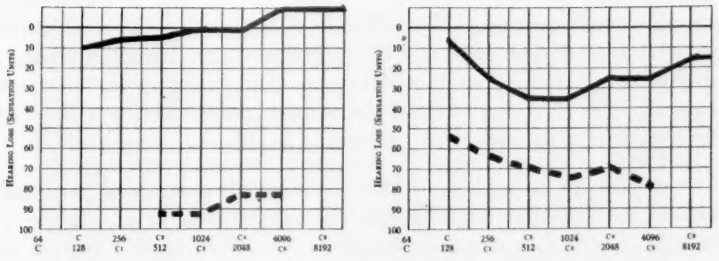

Fig. 1.—Hearing curve and stepedius reflex of a patient with chronic middle ear infection. The solid line indicates hearing sensation on the normal right ear. The broken line designates the threshold of the stapedius contraction on the left ear. The large difference between hearing sensation and reflex-response can be explained by a mechanical impairment of the stapedius movements due to scars.

Fig. 2.—Observation of the stapedius reflex on a patient with a perforation of the ear drum. The threshold of hearing sensation (shown by solid line) is compared with the threshold of stapedius contractions (indicated by broken line). The minimum difference is 35 db.

Figures 1 and 2 show hearing curves of patients compared with the threshold of the stapedius contraction. The lower line represents the threshold contraction of the stapedius muscle while the telephone membrane of the audiometer was held against the ear on the opposite side. As seen in these curves the threshold of the reflex is at least 35 db. (Fig. 2) or even more (Fig. 1) below the threshold of hearing. This is one of the fundamental physiological facts about the reflex, and at the same time a limitation for its clinical use. The reflex acts as a protective mechanism for the inner ear to diminish too strong amplitudes. Low intensities do not produce a reflex contraction. Our clinical observations comprise about 40 cases. The significant finding in all the cases which have been studied is the parallelism between the hearing sensation and the reflex. From the observations which we have been able to make it appears that the stapedius reflex is an integral part of the human ear, comparable in function to the light reflex of the pupils.

The afferent branch of the reflex arc is the acoustic nerve. Section of the eighth nerve abolishes both the tensor and the stapedius reflex in animals. The central part of the reflex is represented in the acoustic nuclei and in association fibers with the trigeminal and facial nerves. The efferent branch for the tensor reflex is the trigeminal and for the stapedius, the facial nerve. The reflex arc works

both crossed and uncrossed; stimulation of one side is followed by simultaneous contraction of both sides. It is a true reflex, independent of the cortex. It occurs in decorticated animals; it disappears in deep general anesthesia, but is present in shallow anesthesia. The disappearance of the reflex contractions was observed in a patient who underwent a general anesthesia.

In contradistinction to the acoustic lid reflex and the pupil reflex, the stapedius reflex is not influenced by surprise, fear or attention. It can be demonstrated repeatedly. However, the patient may be "conditioned" by repetition and may show contractions due to expectation. Therefore, it is not wise to arrange the acoustic stimuli at regular intervals. If this precaution is taken errors from this source are easily avoided.

The importance of the acoustic stapedius reflex for practical clinical purposes is limited. Observation of the reflex can be used to rule out an organic lesion in patients suspected of malingering. It is possible also to diagnose the absence of peripheral deafness in children.

Every practicing otologist has numerous patients with a visible stapedius tendon. Either a perforation or a radical mastoid cavity is suitable. As sound source for orientation a Bárány noise box is recommended. With good light, fixation of the patient's head and a loupe (13 diopters is favorable) every otologist can observe an active acoustic stapedius reflex. Naturally not every visible stapedius tendon will give a positive reflex, because fixation of the stapedius due to adhesions may arrest the motility of the stapedius tendon. Secondly, fairly good hearing is necessary because the reflex is 40 to 50 db. below the threshold of hearing. If the ear has already a loss of 80 db., there would not be enough sound intensity available to elicit the reflex. In these cases, an amplifier used in conjunction with the audiometer will elicit the reflex contractions.

Compared to other acoustic reflexes, as the acoustic lid reflex, the acoustic pupillary reflex, and general muscle reflexes, the stapedius reflex is the only one which permits quantitative threshold determinations and even "equal loudness" determinations: Two tones of different pitch and intensity can be compared for the strength of the contraction they will produce. It is hoped that further observation on over-threshold determinations will reveal more information on the function of the cochlea.

The observation of the stapedius tendon is possible only if there is a perforation or destruction of the ear drum. The attempt was

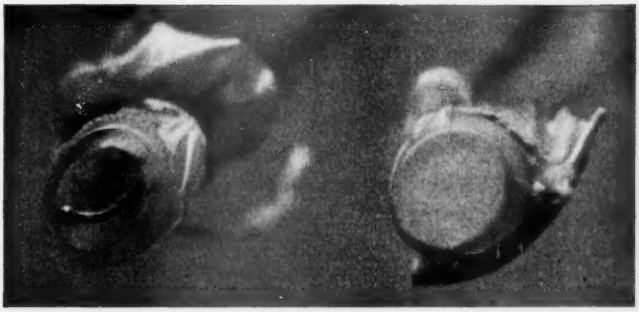

Fig. 3.—A demonstration of induced transparency of a membrane. This picture shows two rubber membranes stretched and fastened over a glass tube. Behind each membrane there was placed a curved metal rod. The distance between the membrane and the rod is about 2 mm. As the control on the right side shows, the metal rod is invisible due to the opaqueness of the rubber membrane. The left rubber membrane was massaged with the potassium iodine solution for 30 seconds. The induced transparency makes possible the visualization of the rod behind the rubber membrane. The size of the membrane is similar to the ear drum. The ear hook placed behind the membrane is meant to represent the stapedius tendon.

made to make the stapedius tendon visible through a normal ear drum in order to obtain a curve of the stapedius reflex on absolutely normal ears. This may be called "induced transparency." Our attempts for this physiological experiment were based on the work of Hartridge.[9] This author suggested a watery mixture to be used as water immersion for microscopy. The prerequisites of induced transparency are similar to the problems of water immersion: the material to be applied must be water-soluble, nontoxic and fast working.

Figure 3 shows the principle of induced transparency in a rubber membrane. The elimination of all rough spots on the surface of the membrane is important. After careful clearing of the canal and ear drum of all dirt, fat or cerumen particles, a mixture of glycerin, water and potassium iodide is gently massaged into the area. Previous anesthesia of the ear drum is generally carried out. However, the procedure can be carried out without the use of local anesthesia. In successful cases the transparency of the treated ear drum begins immediately after a few strokes with the fluid. The transparent area could be called an "optical perforation."

Not every ear drum can be successfully treated for artificial transparency. If gentle massage of three minutes' duration does not

make the examination possible, we consider the attempt a failure and abstain from further attempts. The number of persons suitable for such examination is further reduced by anatomical variations of the outer ear canal. Too narrow canals or excessive curvatures increase the technical difficulties to such an extent that these cases better be omitted.

The physical background of artificial transparency of the human ear drum is as follows: In an organic, living membrane such as the ear drum, we have a mixture of cells, fibers, blood vessels, and nerves; in other words the membrane consists of a variety of tissue elements. Each tissue element is different optically from its neighboring structure. Transparency is based on the optical quality of homogeneity; that is, all structural elements possess the same refractory index. The ideal case of transparency exists when *all* rays pass through the body. However, a part of the light waves will always be absorbed or reflected by the drum. For all practical purposes, the method achieves only that stage in which enough light waves penetrate and only a small amount are absorbed or reflected. The greater the percentage of penetrating rays, the farther one can see beyond the ear drum. If an object is held directly behind a ground glass, it will appear relatively sharp. If it is moved farther back, it becomes hazy and indistinct. In the case of the middle ear, it was observed that the tendon of the stapedius stands out clear, and that the medial wall of the tympanic cavity is indistinct because of the greater distance of the latter from the drum. In cases of retraction, the distance between the drum membrane and stapedius tendon is diminished. The retracted condition, therefore, is favorable for artificial transparency.

In order to minimize dispersion and reflection of light on the surface of the ear drum, the surface is freed carefully of all cerumen and epithelial scales.

The optical refractory index of connective tissue is $N_D = 1{,}547$. The refractory index of our solution is 1.5296. In cases of artificial transparency on cadaver specimens no histological change in the ear drum was found. The changes which occur in the "optical perforation" do not give any visible change in microscopic appearance.

The method of artificial transparency of the ear drum is not presented here as a well-founded clinical method but as an experimental attempt by which it was possible to compare the numerous observations on pathological ears with a few selected normal ears. A few physiological questions could be answered by the use of this method.

First, the pitch of the maximum reflex contraction was determined. It was found in the area of maximum sensitivity of the ear and not at the resonance frequency of the ossicular chain.

Secondly, it was evident even by observation with the naked eye that the contraction of the muscle is slow under normal conditions. In view of the suddenness of acoustic shock pulses it can easily be seen that the middle ear muscle reflex is a poor safety device for impacted loud tones because of its slowness. It must be concluded that the ear is unprotected and for this reason damaged on account of the long latency time of the stapedius and the tensor reflex. An explosive blast may last 1/1000 of a second while the latency time of the muscle is in the neighborhood of 1/100 of a second.

SUMMARY

It is realized that subjective hearing tests contain many potential errors. Objective determinations of cochlear function are needed. At the present time the acoustic reflex of the stapedius muscle is the only muscle reflex which can be used for quantitative tests in man.

The reflex contractions of the stapedius muscle are due to acoustic stimulation of the cochlea.

The number of patients who have a visible stapedius tendon and show movements due to reflex contraction of the muscle is larger than most otologists realize. Every clinician can observe the reflex if he observes the stapedius tendon under proper experimental conditions. In some patients, the tendon can be made visible by "artificial transparency."

In patients in whom the stapedius contractions are visible, or can be made visible, objective hearing tests can be performed for the following:

1. Demonstration of cochlear function in infants or patients too young to give reliable responses in hearing tests.
2. Demonstration of cochlear function in psychiatric patients.
3. Demonstration of cochlear function in malingering.

A study of the literature reveals that otologists have not availed themselves in the past of the stapedius reflex as an indicator of cochlear function.

The otologist who wants to use this objective method has to be familiar with the physiology of the reflex.

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LXXXVII

TANTALUM-ACRYLIC MIDDLE EAR PROSTHESIS

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It is no longer necessary to call the attention of the otolaryngologists to the merits of the artificial middle ear. Largely through the work of A. G. Pohlman,[1] this device is recognized today as one of the foremost means of restoring hearing to those deafened by chronic otitis media. Unfortunately, the great contributions of Lempert and his pupils in the field of otosclerotic deafness have made us somewhat less conscious of the bigger problem of hearing loss due to chronic otitis media.

In the ear that has been subjected to radical mastoidectomy, as well as in many unoperated ears, the greatest diameter of the external auditory meatus exceeds that of the introitus. This anatomical situation precludes the use of a rigid prosthesis conforming to the configuration of the canal. Pohlman[2] has advocated certain plastic surgical procedures and the modification of certain established otosurgical procedures to obviate this difficulty.

The tantalum-acrylic middle ear prosthesis, a modification of the Pohlman prosthesis which can be fitted to patients having radical mastoidectomy cavities, consists of an acrylic frame which is fitted to the concha and a tantalum tube which is attached to this frame and lies within the external auditory meatus. The proximal end of the tube is covered by a Cargile membrane diaphragm held in place by a tantalum ferrule and pierced centrally by a rosin-coated nylon rod having an expanded proximal tip.

This prosthesis eliminates the fitting problem by avoiding it; instead of conforming to the canal, the device is coapted to the concha of the external ear, and the fitted acrylic tube of Pohlman is replaced by a straight metal cylinder which is supported externally.

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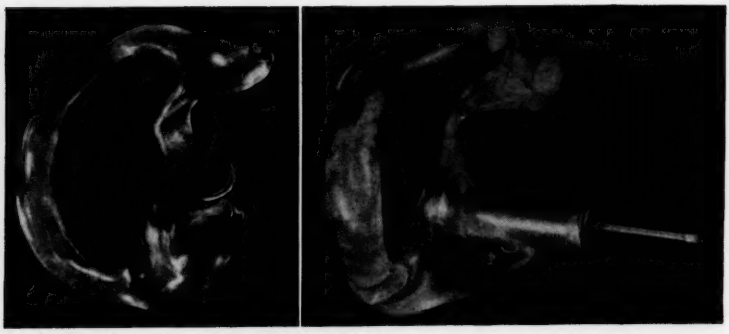

Fig. 1*A*.—The tantalum-acrylic middle ear prosthesis; medial aspect.

Fig. 1*B*.—The tantalum-acrylic middle ear prosthesis; posterior aspect.

In addition to adaptability to radical mastoidectomy cavities, the tantalum-acrylic prosthesis offers certain other advantages:

1. The impression is taken under direct vision of the sensitive spot on the promontory. This enables the otologist to direct the cylinder in such an axis that the shaft of the finished appliance automatically contacts that area; in fact, it is difficult to avoid striking this area. The difficulty patients encounter in establishing this contact is a major fault of the existing devices.

2. There is less damping of the vibrations on the walls of the tube, since it is free of curves.

3. The prosthesis is accessible to the patient. He has no difficulty in inserting it, removing it, adjusting it, or repairing it. No special instruments are required. The patient is less dependent on the otologist.

Since the prosthesis is suspended from the auricle, it is better adapted to patients who have had radical mastoidectomy than to those who have not, because of the cicatricial fixation of the auricle which follows this operation. However, the appliance is also adaptable to a few unoperated ears that are not especially mobile with facial and mandibular movements. In either case, a certain amount of motion is unavoidable and is usually not objectable.

Tantalum tubing was chosen for use in this prosthesis because it is available with extremely thin walls which permit maximum diaphragm area; yet the physical characteristics of the metal are

such that great strength and rigidity are obtainable even with such thin walls. Tantalum tubing was first used in the ear by Strain and Pedersen[3] in the treatment of meatal atresia.

Impression Technic: 1. The acoustic probe of Pohlman is used to select the most sensitive area on the promontory; this is marked with an aniline dye.

2. The distance between the promontory and the lateral surface of the concha is noted; half of this distance seems to be the optimal length for the metal tube.

3. The proper diameter of the tubing is determined by inserting trial tubes of various sizes. The largest tube which does not produce discomfort or undue motion by contact with the anterior wall of the cartilaginous canal is selected.

4. The distal end of the tube is then flared and forced on to an ear speculum, which serves as a handle for the tube and permits direct observation of the previously marked area on the promontory while the impression is being taken. The tube is now inserted into the canal, so that it protrudes for a distance of 2 to 3 mm.

5. A small quantity of alginate impression material is prepared and packed into the concha around the tube and speculum. The dyespot is sighted through the speculum and the patient is requested to open his mouth as wide as possible. The otologist observes the dyespot constantly until the impression material has hardened. Great care must be taken in removing the impression from the ear. It must be immersed in water immediately and invested in plaster within a few hours.

The otologist may elect either to process the impression himself if he has the time and the necessary technical skill, or to send it to a dental laboratory for processing. In either case the speculum must be left in place until the impression has been invested.

Processing Technic: 1. The impression, while still wet, is painted with a thin plaster mixture and is vibrated into the lower half of an ordinary denture flask, the speculum being allowed to protrude.

2. The speculum is detached from the impression material after the plaster has hardened. The surface is coated with a separating medium, such as petrolatum or soap, and the upper half of the mould is poured. When this has hardened, the two halves of the flask are separated and the impression material is removed.

Fig. 2.—The prosthesis in place.

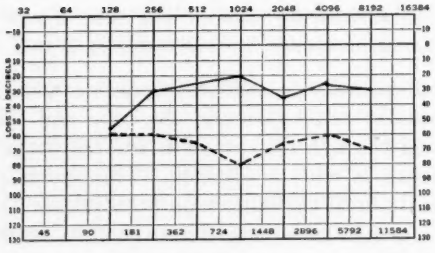

Fig. 3.—Audiogram. Solid line: with prosthesis; dotted line: without prosthesis. This audiogram represents the greatest hearing improvement in terms of decibel gain that the authors have obtained in any of their cases.

3. The negatives are painted with a liquid foil substitute and are packed with either clear or pink methyl methacrylate monomer-polymer mixture. Several trial presses are performed to insure the proper amount of acrylic, the excess being removed each time. The flask is then placed in the flask press and is immersed in boiling water for one hour, after which it is permitted to cool slowly at room temperature.

4. The prosthesis is now removed from its plaster investment and is trimmed and polished with the aid of a dental engine.

After processing, a tantalum ferrule is fitted to the proximal end of the tube and a Cargile membrane diaphragm is attached.

The nylon rod is made twice the length of the tantalum tube plus about 6 mm. When this is flamed to form a knob at the proximal end, and is placed in position in the prosthesis, it will be fairly well balanced, the diaphragm acting as a fulcrum, and will project out of the distal end of the tube so that the patient can make the necessary adjustments. A fine, wax-tipped bamboo rod will give higher amplification, but may approach the threshold of painful hearing.

The prosthesis must be well-fitted; minor errors in impression technic may produce intolerable pain and discomfort. The patient is entirely unaware of the presence of a well-fitted prosthesis.

Our experience with the prosthesis is quite limited; we are, therefore, unable to present a significant evaluation of it at this time. It is hoped that the device will be used and improved upon by others, since it appears to have a great deal to offer a large group of patients.

SUMMARY

A modification of the Pohlman diaphragm-rod artificial middle ear is presented. This device is specifically designed to make the benefits of the Pohlman prosthesis available to patients with radical mastoidectomy cavities.

The impression technic is rapid and simple; the processing need not be done by the otologist.

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LXXXVIII

BLEEDING FOLLOWING TONSILLECTOMY AND ADENOIDECTOMY

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Many factors may predispose to or cause postoperative tonsillar bleeding. For purposes of description, the condition is divided into primary and secondary types. Primary bleeding occurs the first 24 to 48 hours postoperatively, while secondary bleeding occurs thereafter and up to ten days postoperatively. Primary bleeding, in the majority of cases, is due to inadequate surgical hemostasis at the time of operation, or occasionally to the loss of a ligature from the throat during the reaction period.

Predisposing factors and causes for secondary hemorrhage include acute febrile diseases occurring during convalescence; dietary deficiencies, particularly vitamins and proteins; hypertension; local infection; local trauma; blood dyscrasias; and certain drugs, notably aspirin, administered either locally or systemically during the convalescence.

It has been our policy to consider the following points in performing tonsillectomy and adenoidectomy in order to minimize bleeding at the time of operation and postoperatively:

1. The study of any constitutional or dietary disorder or blood dyscrasia which may interfere with the clotting of blood,

2. The control of all active bleeding points from large vessels immediately upon removal of the tonsil,

3. The free use of a pharyngeal aspirator in the fossa after ligation of active bleeders to observe closely for any oozing or active bleeding,

4. The use of topical preparations to aid the clotting of blood,

5. Proper instructions to the patient so that trauma to the operative site is minimized, and

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6. The avoidance of medication causing or contributing to secondary hemorrhage.

Upon admission of the patient, an effort is made to determine any history of abnormal bleeding following minor injuries, and of familial tendencies toward bleeding. The patient is likewise questioned as to an adequate dietary intake. Any positive findings in the history calls for adequate blood studies and prophylactic medication when possible, in order to correct blood abnormalities before proceeding with the operation.

At operation, immediately after removal of the tonsil by sharp dissection, a quick survey of the bleeding points is made. A sponge may be inserted into the upper or lower pole area to segregate one from the other, while bleeding points in the exposed area are controlled by clamping and placing a slip knot of plain No. 1 catgut around them. A Kelly clamp serves adequately for both purposes. Cohen[1] was probably the first to describe the technic of ligation of bleeders in the throat. Catgut is used because it is absorbable and is relatively safe if aspiration of the ligature should occur. Upon swelling, it causes the knot to be drawn tighter and thus makes feasable the use of the easily applied slip-knot. In this manner the majority of bleeding is controlled quickly and efficiently. When the fossa is thus rendered essentially dry, a sponge is inserted and a similar procedure is carried out on the opposite side. There is no point in the tonsillar fossa which is not accessible to the ligature method as described. Occasionally, in a throat where the fascia of the tonsillar bed has been diseased or has become fibrosed, the clamp and free ligature method may serve only to tear the muscle and fascial bed. This may require the introduction of plain catgut sutures in figure of 8 fashion, using a small, stout, round needle. A minimal number of instruments is used routinely for tonsillectomy: a Lillie-Dean tenaculum, three small Kelly clamps, a tonsil scissors, one sharp double-edged Seiler tonsil knife, a Davis gag and a metal pharyngeal aspirator. It is of utmost importance that the aspirator be used freely in the fossa, not to the point of causing edema or wasting time unnecessarily, but sufficiently so as to make sure that no clots are present which will become dislodged as soon as the pharyngeal reflexes return. The patient is returned to the room only when the fossae are completely dry and no oozing is noted. Then, and only then, has the otolaryngologist fully and competently completed the operation.

The removal of the adenoids is accomplished by using Beckman or Barnhill curettes of varying sizes. A large one is used to remove

the central mass while smaller ones are used to remove the tissue situated laterally. Bleeding from the nasopharynx is controlled by placing, with moderate pressure, several gauze sponges into the nasopharynx. By careful curettage, injury to the posterior nasal septum is avoided and bleeding from this area is thus minimized. When the adenoid tissue is removed cleanly, little difficulty is encountered in establishing hemostasis. The usual point of bleeding which has confronted the authors has been the cut surface of the pharyngeal mucosa just behind the free margin of the soft palate. This is easily controlled by the ligature method described. Occasionally bleeding from the posterior wall of the nasopharynx, particularly in adults, continues after the original sponges are removed. Sponges are again inserted and allowed to remain in the nasopharynx for several minutes. If bleeding recurs after their removal and palpation of the nasopharynx reveals that all tissue has been cleanly removed, it is expedient to insert a nasopharyngeal pack, to be removed later at the bedside.

We call attention to those fossae in which no active bleeding points are noted but where there is a general ooze from a part of the tonsillar fossa. In such cases, a combination of thrombin and one of the absorbable hemostatics may be used to great advantage. Thrombin solution[2] is applied to the fossa using a Luer-Loc syringe and fistula needle, after which the fossa is observed for several minutes. If oozing still persists, a "patch" of absorbable hemostatic is placed over the area and a suture of plain catgut is placed through the sponge and one pillar to prevent dislodgement during the reaction period. The same procedure may be followed for bleeding from the adenoid region but here no suture is necessary to hold the sponge in place. It has occasionally been advisable to place a hemostatic sponge in the fossa and suture the pillars together over this. In these cases the sponge is usually absorbed in three to five days.

It occurred to the authors that if one could protect the raw wound and obliterate the empty space, the incidence of postoperative tonsillar hemorrhage might be reduced materially. In accord with this, a number of patients were operated upon and an absorbable sponge was packed into the fossa and the pillars sutured over it tightly. The results were uniformly discouraging due to the marked postoperative pain, so that the procedure was discarded. No protection for the raw surfaces has yet been devised, and trauma as a cause of bleeding remains a major problem to the otolaryngologist.

Like other widely practiced operations, tonsillectomy has unfortunately come to be regarded by many somewhat lightly, and as

having no special risk. Christopher's textbook states that the mortality from tonsillectomy is the lowest of any surgical procedure, considering the great number of operations performed (Richards).[3]

Under the heading of dietary deficiencies fall a number of conditions which may cause or predispose to bleeding following tonsillectomy and adenoidectomy. Elements that may be lacking from the diet are fluid, vitamins, protein, minerals and inorganic elements such as iodine, calcium, phosphorus, sodium and iron. The vitamin deficiencies have been extensively investigated in recent years and much emphasis has been placed on the roll of vitamin K and tonsillar hemorrhage.[4]

Vitamin C has been shown to be important in prompting normal wound healing.[5] Lund and Crandon[6] showed that a marked deficiency in vitamin C caused a lack of intercellular substance and capillary formation in wounds. Neivert et al[7] reported a below-normal preoperative vitamin C plasma level in 54.5% of a series of 246 patients undergoing tonsillectomy. They administered vitamin C along with liberal quantities of acetylsalicylic acid in a series of tonsillar operations and reported a better than 50% reduction of late tonsillar hemorrhage in those receiving vitamin C. They conclude that vitamin C aids in the prevention of the salicylate-induced hypoprothrombinemia. By employing vitamin C, a 4.1% incidence of late tonsillar hemorrhage was reported.

The authors administered vitamin C without salicylates in a limited number of post-tonsillectomy cases and observed that the wounds appeared cleaner but no acceleration in the normal healing was noted. The administration of vitamin C is considered to be indicated in those patients suspected of suffering from a deficiency in this vitamin. However, the authors do not employ it routinely.

Vitamin P has been found to be of value in certain cases of hemorrhage due to increased capillary fragility.[8] However, the response to continuous oral administration of vitamin P becomes manifest only after two to three weeks. From the standpoint of time, therefore, vitamin P would be of little value in preventing late tonsillar hemorrhage unless it were given several weeks in advance of the operation. No clinical work on this subject has been done by the authors but they feel that capillary fragility is not often a factor in late tonsillar hemorrhage.

An adequate protein intake is essential for normal convalescence and wound healing. White and Weinstein demonstrated that nitrogen catabolism is increased after surgery, fractures, trauma, or during

hyperpyrexia.[9] In a study of uncomplicated herniorrhaphies in healthy males, over a 9.9 day period, there was an overall deficit of 613 grams of protein. One gram of protein per kilogram was advocated daily to maintain a positive protein balance. Obviously, protein deficiency must be seriously considered and corrected in tonsillectomy cases as in other surgical procedures.

The important blood dyscrasias include anemias, leukemias, hemophilia and the purpuras. It is impractical to carry out routinely the number of tests designed to determine the presence of various dietary deficiencies or unusual blood dyscrasias. We feel that the usual private patient undergoing tonsillectomy and adenoidectomy is not suffering a dietary deficiency sufficient to predispose or cause bleeding following tonsillectomy. In regard to blood dyscrasias, a history is taken for familial or past tendency toward undue bleeding. If a positive history is obtained, a complete blood survey is made. Routinely, however, a hemoglobin determination, white cell count, and differential smear are carried out. If these prove abnormal, complete blood studies are then performed. We have found little value in routine bleeding and clotting time determinations. Haffly[10] likewise states that the routine determination of the blood clotting time is of little value in the avoidance of postoperative hemorrhage.

In an effort to prevent many of the common factors causing secondary tonsillar bleeding, each patient (or the parents in the case of a child), is guided during the first week of convalesence by a set of specific and detailed written instructions. Verbal instructions are often forgotten and are unsatisfactory.

Since the tonsillectomy or adenoidectomy wound must necessarily heal by second intention, the possibility of bleeding is much greater than in closed clean wounds. Secondary infection in the crust formed over the granulating wound of tonsillectomy increases the amount of slough and the possibility of vessel erosion, thereby producing secondary bleeding. An attempt has been made to overcome this major problem by the local use of sulfonamide compounds. McGovern,[11] in his admittedly small series, using a sulfonamide locally, reported two postoperative hemorrhages among 150 cases. It is generally conceded, however, that sulfonamides locally cause a definite vascular ooze with serum exudation and an increased incidence of hemorrhage.[12] Sensitization to the sulfonamides is not unlikely and is undesirable should it occur. More recently, the authors have conducted a series of cases using troches containing benzocain and tyrothricin postoperatively, resulting in cleaner, minimal granulating fossae with no incidence of late tonsillar hem-

orrhage in a number of cases.[13] Lozenges were chosen since work done by MacGregor and Long[14] using methylene blue lozenges demonstrated that five minutes after the lozenge was placed in the buccal fold, the anterior pillars of the fauces, uvula and the tonsils were stained considerably. They further state that the efficacy of medicated lozenges depend on the direction of the salivary flow, which varies with individuals and with posture. Tyrothricin was chosen as the antibiotic for local use rather than penicillin since the development of a sensitivity to the penicillin would be undesirable if a more urgent need for the drug should arise at some later date. In addition, marked glossitis has been observed by the authors in numerous cases where penicillin troches were used.

Of the various drugs given during the convalescent period, much attention has recently been focused upon the role of vitamin K and of acetylsalicylic acid. Neivert[4] recently reported a 10% incidence of late tonsillar bleeding in patients who used aspirin freely, both orally and in chewing gum, during the postoperative period; and an incidence of only 1.4% of late bleeding in those given aspirin orally and rectally along with vitamin K. (It is to be noted that these latter patients did not use aspirin chewing gum). Neivert concluded that the cause of the late tonsillar bleeding was a hypoprothrombinemia induced by the salicylates, which could be prevented by the simultaneous administration of vitamin K.

Recently Livingston and Neary[15] reported a small series of 45 tonsillectomy patients in whom prothrombin studies were made. Twenty-nine of this group received five to six tablets of aspirin chewing gum daily from the first to the seventh postoperative day. There was an incidence of 6.6% of late tonsillar bleeding, and there was no decrease of blood prothrombin in these cases. A control group of 16 patients received aspirin chewing gum in similar dosage and, in addition, 0.5 mg. of synthetic vitamin K. The incidence of late tonsillar bleeding was 6.3%, and again no decrease of blood prothrombin was noted. Livingston and Neary conclude that " . . . there is no indication that the routine post-tonsillectomy use of chewing gum containing acetylsalicylic acid may give rise to prothrombinopenic hemorrhage or that such use of this gum has any adverse effect on blood prothrombin".

The authors, in recent articles,[13, 16] reported a total of 687 cases of tonsillectomy and adenoidectomy studied by them. Group 1 included 216 patients who used aspirin chewing gum as desired throughout the postoperative period. No other medication was prescribed or used (other than codeine for the adults). Of this

number, 9.7% reported late (secondary) bleeding. In Group II, 128 patients took 10 mg. of synthetic vitamin K twice daily for seven days postoperatively along with aspirin chewing gum as desired. (Codeine was prescribed for the adults.) In this group there was a 10.1% incidence of secondary bleeding. Group III consisted of 343 patients who were not permitted to use aspirin chewing gum at all. No synthetic vitamin K was taken by them. (Codeine was prescribed for the adults.) The incidence of late bleeding in this group was 0.58%.

The authors concede that the simultaneous administration of vitamin K with salicylate will protect a normal individual against a salicylate-induced hypoprothrombinemia, but hypoprothrombinemia is not considered the usual cause of late tonsillar bleeding. It is still felt that the high incidence of late tonsillar hemorrhage in patients using aspirin chewing gum is due to some local effect on the wound. Since most physicians administer the drug in the form of chewing gum, the local action of salicylates becomes of paramount importance and the hypoprothrombinemic effect of lesser importance.

Considering the local effect of aspirin further, Ersner et al[17] showed that when saliva and blood are mixed the blood coagulation time is shortened. A mixture of saliva, blood and aspirin solution showed a definite hindrance to blood coagulation and other such strongly acid solutions produced similar effects. From the foregoing it is felt that aspirin chewing gum, or similar locally acting drugs, must be avoided entirely during the postoperative period.

In order to determine the possible effects of an antibiotic (tyrothrycin) and of a local anesthetic (benzocain) on tonsillar wound healing and late tonsillar bleeding, 159 patients were studied in Group III of our series.[13] These patients were provided with troches containing benzocain and tyrothricin but did not use any other medication postoperatively. No case of postoperative bleeding occurred in this sub-group. The fossae were uniformly cleaner and free from excessive granulation tissue. The relief afforded by the local anesthetic (benzocain) in the lozenges was generally satisfactory.

Having discussed the causes and prophylaxis of tonsillar bleeding, it is readily admitted that many tonsillectomies and adenoidectomies have been done without such precautions with little, if any, postoperative bleeding. However, an over-all picture of postoperative hemorrhage does not justify such action.

SUMMARY AND CONCLUSIONS

1. Postoperative tonsillar hemorrhage is divided into primary and secondary types, and the causes for each are presented and discussed.

2. A method of tonsillectomy and adenoidectomy is presented. The importance of the pharyngeal aspirator and of free-tie ligatures is stressed. The use of the newer hemostatics is discussed.

3. The relation of various drugs to late tonsillar hemorrhage is reviewed. Special reference is made to vitamin K and aspirin, and the local use of tyrothricin.

4. A series of 687 cases of tonsillectomy and adenoidectomy is reviewed to show the effects of aspirin chewing gum and vitamin K on secondary tonsillar bleeding.

5. It is felt that the local use of aspirin is a major factor in late tonsillar bleeding and should therefore be avoided.

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LXXXIX

A METHOD AND APPARATUS FOR THE RAPID PERFORMANCE OF SKIN TESTS

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It has been only within recent years that we have begun to realize the importance of an underlying allergic factor in the chronicity of the infections of the nose and paranasal sinuses. Shambaugh[1] states that at least 70% of chronic sinus infections and 90% of chronic nasal infections can be shown to have an underlying allergic factor responsible for their chronicity. Other investigators do not place the percentage so high, but still the allergic factor is so prominent that disregarding it entirely will mean failure of cure in many cases. It will require a fine balance of the combating of infection combined with allergic management for any measure of success in the treatment of many of the conditions involving the upper respiratory tract and associated structures. It is obvious that the physician dealing with infections and altered physiology of the ear, nose and throat must have a good working knowledge of the mechanism and manifestations associated with the hypersensitive state. In a given case of suspected allergic involvement, it is not only necessary to arrive at a diagnosis of allergy, but the physician must determine the type of allergy and the specific offending substance responsible for the symptoms before any intelligent treatment can be instituted. The limited resources of many of our patients makes it financially impossible to consult an allergist as well as an otolaryngologist for the relief of his symptoms.

A good history is by far the greatest diagnostic aid we have in arriving at the correct solution, and it goes without saying that a careful history must be followed by a complete physical examination. In many instances, however, the history and physical examination must be supplemented by laboratory studies and cutaneous tests before an accurate diagnosis can be made. Despite the controversy and criticism regarding the value of skin tests, they are often of great diagnostic aid, but they are only of value in diagnosis when they are carefully done, adequately checked and properly interpreted; otherwise, the procedure may be very misleading and result in hopeless confusion for the doctor as well as the patient.

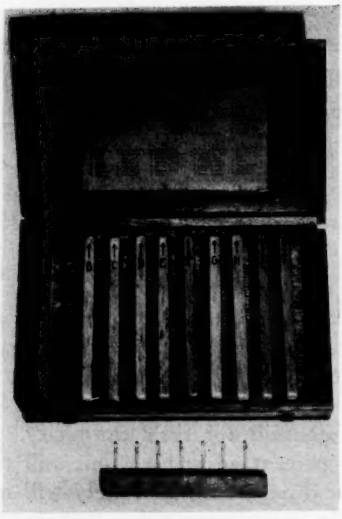

Fig. 1.—The apparatus used in the rapid performance of skin tests.

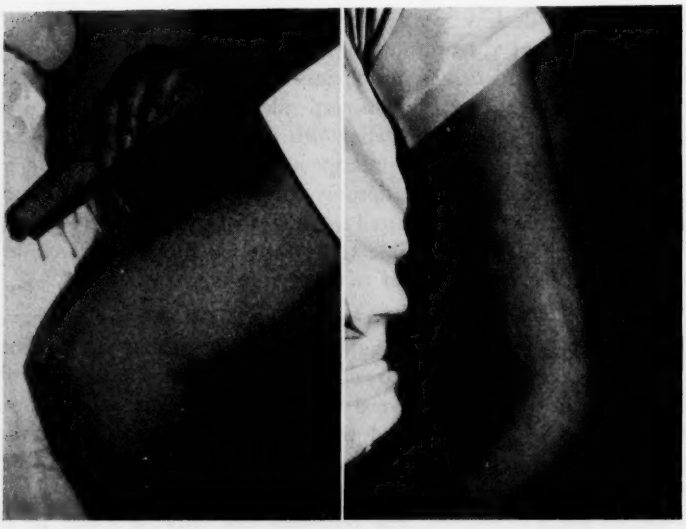

Fig. 2.—Method of applying liquid antigen to the skin test site.

Fig. 3.—A clinical case of pollinosis showing strongly positive reaction to timothy and seven varieties of spring grasses with minimal or no reaction to thirteen other antigens tested.

Skin testing—aimless, excessive and misunderstood—has done more than its share in bringing allergy into disrepute. The time consuming process of innumerable cutaneous tests is neither practical nor necessary, and the practitioner in a busy office or clinic cannot take the time to carry out innumerable tests, and cannot delegate this procedure to inexperienced technicians without running the risk of obtaining unreliable results or wasting valuable time that could be spent on more fruitful examinations. As a result, many cases are not adequately studied and the diagnosis is deferred, or the patient is treated symptomatically for many weeks before the true nature of the condition is determined and the distressing symptoms brought under control.

The purpose of this paper is to present a method of quick, reliable and adequate diagnostic skin testing, applicable in the office of a busy practitioner. This method is accurate and can be used as part of the routine examination in cases of suspected allergic involvement without increasing the time ordinarily required for the study of a new case. In the past it was necessary to make special appointments for patients requiring skin tests and the time consumed in the preparation of the patient and actual skin testing necessitated the loss of at least 45 minutes for either the nurse or doctor from other activities in the office. As a result skin testing procedures were deferred and the diagnosis was often delayed rather than sacrifice the time. With the proposed method of testing the patient can be tested at the first visit along with other routine studies, and if the patient has been referred by another physician for diagnosis and treatment, as is often the case, the consultant can arrive at a more accurate and intelligent diagnosis to the mutual benefit of all concerned and at less cost to the patient. In the past, owing to cumbersome and time consuming methods of cutaneous testing, it was impossible to test adequately very many patients in a day without great hardship to the entire office personnel. A procedure that in the past required 45 minutes can now be carried out in 10 minutes and the results are more accurate and less discomforting for the patient and doctor. If, for any reason, complete tests are not required, certain groups of antigens can be done at the first visit and further studies carried out at subsequent visits if necessary. The tests can be done on the skin of the outer surface of the arms and the patient can rest in the waiting room until the tests are read, thus saving a consulting room for other patients, as well as time, space and delay required for the patient to disrobe for cutaneous testing on the skin of the back.

This apparatus employs a rapid method of applying liquid allergic extracts to the skin area to be tested and the testing is carried out by the needle puncture method. The skin method is used because there is less dermographic reaction of the skin with less chance of false positive reactions and misinterpretation of tests. Most allergic individuals show some degree of dermographia, and in many cases the skin tests are difficult to read due to this phenomenon. In following the scratch technique it is almost impossible even for the most skilled and experienced technician to use the same degree of pressure and make the same sized abrasion without variations of the size and depth of the abraded area, all of which results in reactions of various sizes, and the trauma to the skin often produces different degrees of dermographia increasing the difficulty of an accurate evaluation of the results. In the puncture method the skin abrasions are uniform and at the same time enough of the liquid antigen is introduced into the skin for diagnostic testing. It has also been found that children can be more easily controlled as the abrasions produced by the skin puncture method cause less discomfort than those produced by the scratch method. Stoesser,[2] in observing children with allergic diseases by a comparative study of skin testing methods, found the puncture technique to give the most satisfactory results.

The apparatus, as shown in Fig. 1, consists of a rectangular box or case in which the liquid antigens are contained in 1 cc. vials. The vials are arranged in ten rows with seven vials in each row. These containers are secured in holes in the base of the case, and in each row of seven vials the holes are spaced 7/8 of an inch apart and the depth of each hole is the same, so that the top or mouth of the vial is level with the next vial. The glass applicators for each of the seven vials in one row are held in a top piece of wood measuring 6½ x ¾ x ½ inches. The underside of the top piece is lined with 1/8 of an inch cork padding and through this surface the small glass applicator rods protrude at the same distance, similar in appearance to the prongs of a garden rake. The applicators are so spaced that each one dips into the center of each of the seven vials in one row to a depth of 1/16 of an inch from the bottom of the vial. When the top piece is in position over the vials the cork undersurface seals the vials. The top of the case is constructed in such a way that when it is closed the top pieces are held firmly over the vials to prevent evaporation or spilling of the liquid antigen. The vials are so spaced in the base of the case that it is impossible to turn the top piece and insert the applicators in reverse order and contaminate the liquid antigen in one vial from the antigen in another.

In testing, the top piece is removed from the group of seven antigens to be tested, and the drops clinging to the applicators are transferred to the skin test site by merely touching the skin with the tips of the applicators, as shown in Fig. 2. This manipulation leaves seven small drops of different antigen uniformly spaced on the skin. A skin testing or vaccination type of needle is then inserted through the center of each drop at an angle of about 20 degrees, the skin is barely punctured, and the point of the needle is lifted up and torn from the skin by a quick motion. The point of the needle is wiped on gauze between each puncture so as to prevent contamination of one skin puncture by the antigen used on the previous puncture. The next group of seven antigens is then tested in the same manner. After the desired number of tests have been made, the excess antigen can then blotted from the skin by gauze or cleansing tissue and the patient can be sent to the waiting room until the tests are read. The tests are read in 15 minutes in the same manner as scratch tests. The uniform results and the equally spaced tests facilitate interpretation. After a little practice the tests can be done very rapidly without sacrificing accuracy for speed. The average time for the testing of 70 complete and different antigens on one patient is ten minutes.

Fig. 3 shows a clinical case of pollinosis showing strongly positive reactions to timothy and seven varieties of spring grasses with minimal or no reaction to 13 other antigens tested.

The seven vial groups are lettered A, B, C, etc., and the vials in each group are numbered from 1 to 7 for accuracy in recording the results. I find that the arranging of antigenic extracts of the more common offenders, such as ragweed, timothy, orris root, karaya gum, cottonseed and house dust in group A, the common epidermals in group B, the common foods in their order of frequency in groups C, D, E, F and G, the common molds and less common epidermals in group H, and the common grasses and trees in groups I and J, gives a wide selection of materials for part or complete testing, depending upon the tests required after the history has been studied. Fig. 4 shows the grouping of antigens for testing and recording. It will be the exceptional case that will require more investigation by skin testing methods.

This method of skin testing has been used in the Department of Otolaryngology at the Geisinger Memorial Hospital, Danville, Pennsylvania, for the past eight months. The method has proved more satisfactory than other methods used in the past, and there has not been observed a single case of constitutional reaction in over 500 allergic individuals tested. This technique is always used before the

patient is skin tested by the intradermal method to determine the degree of sensitivity prior to the institution of desensitization therapy.

This method is not entirely original as a similar apparatus was described by Simon[3] in 1941. Simon, however, employed the scratch method of testing which is more time-consuming and not as accurate, and his apparatus applied 24 separate antigens at one time, thus reducing the degree of flexibility in the choice of antigens. Mitchell[4] carried out a series of comparative tests using the same antigen and comparing the skin puncture test with the scratch test, the tests being made side by side on the same patient. He found the puncture tests to show as many positive reactions in clinically proven cases of allergy and noted that there was less dermographia. He concluded that the skin puncture method of skin testing was no less accurate than other accepted methods of testing and that in cases of dermographia, interpretation was less difficult.

This method of rapid skin testing is offered only as an aid in the diagnosis of allergic conditions and in no way is intended as a diagnostic automat. The limitations of skin tests as an aid to diagnosis must be realized. Skin tests are more likely to be accurate and reliable when the allergen is an inhalent. Regardless of the degree of reaction, the positive substances must be logically related to the patient's history and should reasonably explain the clinical picture. Elimination of the allergen causing the positive reaction should produce the expected relief, and exposure to it should result in a clinical attack. Negative reactions in the face of strongly suspected allergic conditions mean that other methods of investigation, such as elimination diets, must be employed.

SUMMARY

Allergic investigation is important in arriving at an accurate diagnosis in many of the conditions encountered in the practice of otolaryngology.

An apparatus and method for the rapid performance of skin tests are presented embodying the features of speed, economy, uniformity and flexibility, without the sacrifice of accuracy and reliability.

GEORGE F. GEISINGER MEMORIAL HOSPITAL.

NAME ..... DATE .....

SKIN TEST BY SKIN PUNCTURE METHOD

A.	B.	C.	D.
1. G. Ragweed	1. Chicken Feathers	1. S. Corn	1. N. Bean
2. S. Ragweed	2. Horse Dander	2. Wheat	2. Pea
3. Timothy	3. Cat Hair	3. Oat	3. Potato
4. Karaya Gum	4. Dog Hair	4. Rye	4. Tomato
5. Orris Root	5. Cattle Hair	5. Rice	5. Cabbage
6. Cottonseed	6. Rabbit Hair	6. Milk	6. Coffee
7. House Dust	7. Glue	7. Egg	7. Chocolate

E.	F.	G.	H.
1. Carrot	1. Chicken	1. Buckwheat	1. Alternaria
2. Beet	2. Beef	2. Flaxseed	2. Hormondendrum
3. Orange	3. Pork	3. Spinach	3. Penicillin N.
4. Cantaloupe	4. Lamb	4. Mustard	4. Goose Feathers
5. Peanut	5. Crab	5. Cocoanut	5. Duck Feathers
6. E. Walnut	6. Oyster	6. Celery	6. Sheep Wool
7. Pecan	7. Salmon	7. Tobacco	7. Silk

I.	J.
1. Lamb Quart.	1. Hickory
2. Sweet V. Gr.	2. Willow
3. Sheep Sor.	3. Elm
4. Orchard Gr.	4. Oak
5. Dandelion	5. Tag Alder
6. Blue Grass	6. Maple
7. June Grass	7. Birch

DERMOGRAPHIA

None .....
Mild .....
Moderate .....
Marked .....

INTRADERMAL SKIN TESTS (0.02 cc.)

		REACTION
Ragweed	Dil.	
"	Dil.	
"	Dil.	
"	Dil.	
Timothy	Dil.	
"	Dil.	
"	Dil.	
"	Dil.	
House Dust	Dil.	
" "	Dil.	
" "	Dil.	
" "	Dil.	
Bacterial Antigen	Dil.	Im. React. ..... Delayed React. .....
"	Dil.	Im. React. ..... Delayed React. .....

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XC

FOREIGN BODIES IN THE AIR AND FOOD PASSAGES; A SERIES OF TWO HUNDRED FIFTY CASES

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The material to be presented is based on the author's consecutive series of foreign body cases (1941-1946) at the Chevalier Jackson Bronchoscopic Clinic. Only cases in which a foreign body was removed by peroral endoscopy are included in this group; cases of suspected foreign body, in which the presence of a foreign body was ultimately disproven, and cases in which the foreign body was allowed to pass spontaneously through the gastro-intestinal tract have been omitted, except for one case which presented unusual problems in management and is therefore described in some detail.

Data regarding incidence of the various types of foreign body, as well as the frequency of their occurrence in each of the several anatomic locations, are shown in Tables 1 and 2. Bones occurred with greatest frequency, constituting 28 per cent of the entire number, and coins were found to be next in incidence, comprising 16 per cent of the entire group. Safety pins (31 open, 2 closed) ranked third in frequency (13.2 per cent), vegetal foreign bodies fourth (10.0 per cent) and meat fifth (9.2 per cent).

In this series, as in those reported by other authors,[1, 6] the age factor appeared to be closely related to the incidence of the various common types of foreign body. Coins, safety pins and vegetal foreign bodies are seen almost without exception in infants and young children, whereas bones and meat occur almost exclusively in patients of the older age group. The incidence of all types of foreign body in the second decade appears to be extremely low, as indicated in Table 3.

In 70 cases (28 per cent of the entire series) bones were the foreign body. More than half of these (39/70) were chicken bones, and those of flat triangular shape predominated, although nearly

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Presented as a Candidate's thesis to the American Broncho-Esophagological Association.

From the Department of Laryngology and Broncho-Esophagology (Chevalier Jackson Bronchoscopic Clinic), Temple University Hospital, Philadelphia.

TABLE 1.

INCIDENCE OF FOREIGN BODIES IN 250 CASES

Bones		70
	Bronchus	2
	Hypopharynx	20
	Esophagus	48
Coins and Other Discs		45
	Esophagus	45
Safety Pins		33
	Bronchus	3
	Hypopharynx	13
	Esophagus	17
Vegetal Foreign Bodies		25
	Trachea	4
	Bronchus	21
Meat		23
	Hypopharynx	1
	Esophagus	22
Dentures		5
	Esophagus	5
Miscellaneous Pointed Metallic		13
	Larynx	2
	Bronchus	7
	Hypopharynx	3
	Stomach	1
Miscellaneous Non-Pointed Metallic		17
	Bronchus	7
	Hypopharynx	1
	Esophagus	6
	Stomach	3
Miscellaneous Non-Metallic		19
	Trachea	3
	Bronchus	6
	Hypopharynx	2
	Esophagus	8

TABLE 2.

LOCATION OF FOREIGN BODIES IN 250 CASES.

Larynx			2
Staple		1	
Common Pin		1	
Trachea			7
Bead		2	
Pebble		1	
Peanut		1	
Peanut Shell		1	
Walnut Kernal		1	
Corn		1	
Bronchus			46
Vegetal Foreign Bodies		21	
Peanut	16		
Pecan	1		
Bean	1		
Orange Seed	1		
Carrot	1		
Broccoli Leaf	1		
Pointed Metallic Objects		8	
Open Safety Pin	1		
Baby Pin	1		
Common Pin	1		
Screw	2		
Nail	1		
Tack	1		
Dental Root Canal Reamer	1		
Non-Pointed Metallic Objects		9	
Closed Safety Pin	2		
Michel Clamps	1		
Steel Shaving	1		
Lead Shot	1		
Metal Cap of Brush Handle	1		
Unidentified Conoid Object	1		
Tooth Cap	1		
Dental Ring	1		
Miscellaneous Non-Metallic Objects		8	
Chicken Bone	2		
Broncholith	2		
Tooth	1		
Pebble	1		
Cotton Applicator Stick	1		
Fragment of Cement	1		

TABLE 2–(Continued)

Hypopharynx			40
Bones		20	
Chicken	11		
Fish	8		
Pork	1		
Open Safety Pins		13	
Common Pins		2	
Meat		1	
Wire		1	
Metal Cap of Crochet Hook		1	
Grapefruit Seed (in pulsion diverticulum)		1	
Wooden Spool		1	
Esophagus			151
Bones		48	
Chicken	28		
Turkey	1		
Fish	9		
Pork	5		
Beef	3		
Veal	2		
Unidentified	2		
Coins and Other Discs		45	
Coins	40		
Buttons	3		
Celluloid Eye Toy Doll	2		
Meat		22	
Open Safety Pins		17	
Dentures		5	
Miscellaneous		14	
Paper	3		
Toy Jack	2		
Barrette	1		
Orange Pulp	1		
Orange Seed	1		
Fragment Peach Stone	1		
Italian Chestnut	1		
Egg Shell	1		
Ring	1		
Bottle Cap	1		
Part Toy Telephone	1		
Stomach			4
Bobette Pin		3	
Staple		1	

one-third were of the double-pointed or spicular variety (fragments of rib or long bones). Further data regarding the type and location of the bony foreign bodies are presented in Tables 1 and 2.

Delays in diagnosis were infrequent in this group of cases, because the symptoms were of sudden onset, continuous and sufficiently severe to demand prompt attention. The patients, almost without exception, consulted a physician immediately or within a few hours, and subsequent delays can in nearly every case be attributed to erroneous impressions of the first physician consulted.

There were 16 cases in which the advice of the first physician consulted resulted in delay. In nine of these, patients had been told, following examination by the indirect method or by palpation with the finger, that there was probably nothing there, that the foreign body had gone down, or that the throat had been merely irritated by temporary lodgment of the foreign body. These patients had been dismissed with gargles or lozenges, without the suggestion that an x-ray examination be made. In several instances the physician had suggested swallowing dry bread or other coarse material in an effort to dislodge the bone, and in three cases an attempt had been made to push the bone down with a rubber tube or bougie.

Roentgen examination of the neck, the swallowing function and the esophagus was carried out in all cases except for the few in which a bone could be seen in the hypopharynx on mirror examination and its relations well determined. Nearly all of the chicken bones were sufficiently opaque to be visible in the lateral neck film, but in a few instances, films made after administration of barium sulfate suspension were more conclusive. The fish bones, though less opaque, could also as a rule be identified in the lateral neck film; adherence of barium added further evidence in several of these cases.

There were only five cases in which a bone had passed beyond the cervical esophagus; in all of these, the foreign body had lodged at the level of the aortic arch. In three of these, the x-ray examination was positive, in one negative (a slender spicule of pork bone) and in one inconclusive.

Removal was accomplished without general anesthesia in all 70 of the bone cases. The adolescent sized laryngoscope was used for most of the cases of bone in the hypopharynx. An esophageal speculum of adult size was employed in several of the cases of bone in the cervical esophagus, but usually an esophagoscope of large caliber was preferred. The bones most difficult to find were those

TABLE 3.

AGE IN RELATION TO INCIDENCE OF COMMON VARIETIES OF FOREIGN BODY

	CASES	0-2 YRS.	2-5 YRS.	5-10 YRS.	10-20 YRS.	20-40 YRS.	OVER 40 YRS.
Bones	70	0	0	2 (3%)	2 (3%)	14 (20%)	52 (74%)
Coins	40	19 (48%)	18 (45%)	3 (7%)	0	0	0
Safety Pins	33	21 (64%)	7 (21%)	2 (6%)	3 (9%)	0	0
Vegetal	25	15 (60%)	7 (28%)	2 (8%)	0	1 (4%)	0
Meat	23	0	1 (4%)	1 (4%)	1 (4%)	2 (8%)	18 (80%)

at or just below the cricopharyngeal level, particularly in cases in which edema and ulceration had occurred as a result of several days' sojourn. The mechanical problems were those of dealing with multi-pointed objects.

Complications were infrequent in this group of cases. Varying degrees of widening of the prevertebral soft tissue zone, as seen in the lateral film, were shown by roentgenograms prior to removal in a number of cases, but actual spontaneous perforation was demonstrated in only two cases. In one of these, a large retropharyngeal abscess had developed following spontaneous perforation of the hypopharynx by a fish bone; this was evacuated coincident with removal of the bone and resolved within a few days. In the second case, a chicken bone (spicular) had perforated the cervical esophagus, as shown by leakage of barium at the time of the initial x-ray examination, but in this case no abscess developed, presumably because of adequate internal drainage. Four of the fish bones were found almost completely imbedded in the wall of the hypopharynx, but abscess did not occur in any of these. In one case of pork bone in the cervical esophagus, the x-ray film made after removal showed escape of barium from the esophageal lumen, but with intravenous feedings, frequent use of mouth wash and systemic administration of penicillin, healing occurred without further complication.

In two cases, a fragment of chicken bone was found in the bronchus. One of these patients, a colored female of 32, had choked and coughed while eating chicken six weeks previously. Following examination of her throat at a local hospital, she was dismissed. Within a few days, however, cough and mild dyspnea developed; the cough soon became productive of greenish-yellow odorous sputum, and fever and pain in the left lower chest had been present for several days before she was referred to the bronchoscopic clinic. Roentgen examination showed abnormal, mottled and stringy density in the basal segments of the left lower lobe. The bone, an irregular fragment consisting of a nearly circular flat portion with three short but rather sharp projecting points, was removed bronchoscopically. Although the roentgen examination four days later still showed considerable residual abnormal density the fever had subsided completely, symptoms were minimal, and a second bronchoscopy showed only a small amount of mucopurulent secretion and a little nonobstructive granulation tissue at the site of lodgment.

In the second case, as in the cases reported by Jackson,[5] there was no history of foreign body. The patient, a white female of 57, had complained of cough, slightly productive, for several months,

with occasional wheezing, but without hemoptysis or fever. The roentgenogram showed abnormal density localized to the basal portion of the right lower lobe. In this case, the bony foreign body was so completely obscured by granulation tissue that it was not seen at the time of the first bronchoscopy; on suspicion of carcinoma, tissue was removed for biopsy. When this was reported negative, another bronchoscopy was done; at the terminal branching of the right lower lobe bronchus, a thin whitish edge was seen. This at first appeared to be one of the branch bronchial spurs, but on palpation it proved to be of bony consistency; it was grasped and removed at the end of the scope. Subsequent roentgenograms showed partial but incomplete clearing of the abnormal density. Although lipiodol bronchograms have not been done, symptoms have almost completely subsided and it does not appear likely that there is any important degree of bronchiectasis.

In 40 cases coins were the foreign body. This constitutes 16 per cent of the entire series. All of the patients were children; only five were over five years old.

In six cases there were respiratory symptoms in addition to the usual complaints of gagging and regurgitation on attempted feeding. In four of these cases the foreign body was discovered only when x-ray films were taken because of persistent wheezing, croupy cough and mild dyspnea; in one case these symptoms had been present for over a month, having been attributed to enlargement of the thymus gland.

Significant delays in diagnosis were not frequent, however. Twenty-one of the patients were seen in less than 48 hours, and for only eight was the interval greater than a week.

In all except four cases, the coin was in the cervical esophagus, lying in the usual coronal plane. In two of the four cases in which a coin had passed on into the thoracic esophagus, arrest had occurred at the level of the thoracic arch. In one case, a quarter had lodged in the lower thoracic esophagus of a nine-year-old boy; in the fourth case, a penny was found above the stenotic esophagogastric junction of a two-year-old girl with congenital short esophagus.

In all of these cases removal was accomplished without complication and without use of any anesthesia, general or local. The esophagoscope was used in only five cases, including the four of coins in the thoracic esophagus. In 30 cases the esophageal speculum, small size, was used, and in five cases in young infants, the infant

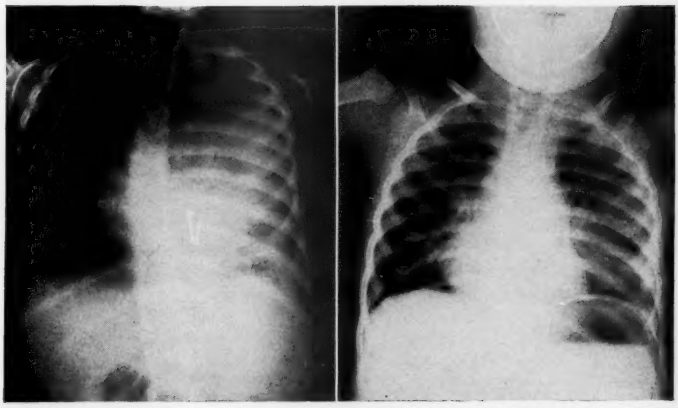

Fig. 1.—(a) Admission film of a child of two years. The open safety pin, originally in the left main bronchus, had been pushed far down into the lower lobe bronchial tree during previous attempts at removal. (b) Roentgenogram made three weeks after bronchoscopic removal under biplane fluoroscopic guidance.

sized laryngoscope was found to provide adequate visualization through the cricopharyngeal orifice.

The group with safety pins comprises 33 cases (13.2 per cent of the entire series). Three of the safety pins were in the bronchus (two closed, one open), 17 were in the esophagus, and 13 were found in the hypopharynx.

In all except one of these cases, the presence of a foreign body had been recognized promptly. In 19 cases, an episode of choking and gagging had been heard or observed by the parents or others; this was followed in some cases by a brief interval which was essentially asymptomatic except that in cases in which feedings were attempted, reluctance to eat and regurgitation were observed. Eight of the children were old enough to report to their parents the fact that they had swallowed a pin. In three instances, refusal of a child to eat led to roentgen examination which revealed the presence of an open safety pin.

The case in which the foreign body was overlooked was one of a safety pin in the bronchus; the patient was a child of two years who had been treated medically for about six weeks (first for a common cold, then for pneumonia). Roentgen examination at the

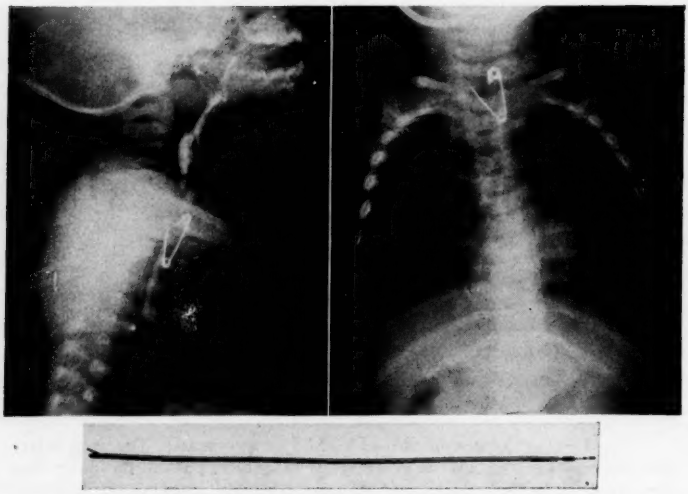

Fig. 2.—Admission films of a child of 13 months; previous attempts at removal of the open safety pin had resulted in a large perforation of the hypopharynx, with mediastinitis and mediastinal emphysema. Cervical mediastinotomy was performed for drainage. The apparatus shown was used to carry the open safety pin into the stomach, whence it passed uneventfully through the intestine. This method was preferred to esophagoscopic removal because of the large perforation and mediastinal complications already present. The afterfilms in this case are shown in Fig. 3.

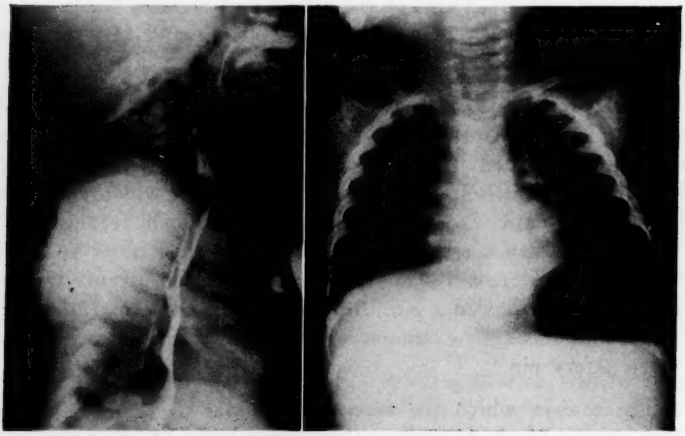

Fig. 3.—Negative roentgenograms, at time of discharge from the hospital, in the case shown in Fig. 2.

end of this time had shown a small open safety pin, apparently in the left bronchus, but an attempt at removal 12 days before admission to the Bronchoscopic Clinic had been unsuccessful. The admission roentgenogram showed the open safety pin, from which a portion of the keeper had been broken, well down in the left lower lobe region, and in addition a rather large pleural effusion. The effusion proved to be nonpurulent, however, and following removal of the pin with biplane fluoroscopic guidance, the pleural and parenchymal densities resolved rapidly (Fig. 1).

In nine of the esophageal cases, the pin was shown by x-ray to be lodged at the cervical level, point uppermost. In five cases, the open pin had been arrested at the level of the aortic arch; interestingly enough in two of these cases the pin was lying point down, with spring end uppermost. In the remaining three cases, the open safety pin was in the lower thoracic esophagus.

In none of the cases did the preliminary examination suggest spontaneous perforation. In one case in which removal of an open safety pin from the cervical esophagus had been attempted elsewhere, a large perforation of the hypopharynx with widespread interstitial emphysema and mediastinitis was evident (Fig. 2). This patient, an infant of 13 months, required external drainage; a cervical mediastinotomy was performed. Penicillin was given in large doses (300,000 units daily) and fluid intake and nutrition provided parenterally. By the fifth day after the drainage the temperature, which was 104° F. on admission, had subsided and the general condition seemed much improved. It was felt that the open pin, lodged at the level of the aortic arch, should not be allowed to remain longer, yet there was hesitancy about attempting esophagoscopy because of the large known perforation of the hypopharynx and the mediastinal complications already present. Since available veins for intravenous feeding were by now exhausted, it was decided to attempt insertion of a small intranasal rubber catheter for feeding purposes.

A No. 10 F. catheter was used; before inserting it, a No. 4 F. ureteral catheter was threaded partway to its lower end. After the catheter was seen by fluoroscopy to enter the esophagus, the ureteral catheter was advanced so that it projected for a predetermined distance of about 6 mm. beyond the eyelet of the rubber catheter (Fig. 2). The forked end thus produced engaged behind the spring end of the safety pin which was then rather easily pushed on down the esophagus and into the stomach, after which the ureteral catheter was removed, the rubber feeding tube being left in place.

The pin was not a large one and as expected it passed uneventfully through the alimentary tract, being recovered in a stool three days later. There were no further complications, except that salivary drainage was evident externally for about twelve days. Administration of barium on the eighteenth day after drainage showed no leakage, however. The feeding tube was removed and the patient discharged in good condition on the twenty-fourth hospital day (Fig. 3).

All of the safety pins in the hypopharynx were removed by the dangling method except in two cases in which the point was easily seen and grasped. In all of the esophageal cases, except the two in which the pin was lodged spring end uppermost, removal was accomplished by endogastric version under biplane fluoroscopic guidance, using a ring rotation forceps. In one case in which the pin did not pass easily through into the stomach, version was accomplished in the lower thoracic esophagus.

In four cases a forceps alone, without esophagoscope, was used. This forceps is an ordinary ring rotation forceps of medium weight, provided with a retractable rubber sheath which protects the forceps blades during introduction through the cricopharyngeal orifice. After it is advanced to the level of the spring end of the pin, the sheath is retracted, a grasp obtained through the spring with fluoroscopic guidance, and the pin then carried into the stomach, allowed to rotate, and brought out with the point trailing. Passage of the forceps through the hiatal opening is facilitated if the forceps is slightly bowed before introduction, so that when being advanced down the esophagus the convexity of its curve is posterior.

The chief application of this modified forceps (Fig. 4) appears to be in cases (particularly in young infants) in which dyspnea due to compression of the trachea from behind occurs on introduction of the esophagoscope.

In 23 cases meat was the foreign body; 18 of the patients were over the age of 40 years. In all of the cases except one, the foreign body was below the cricopharyngeal level; this patient was a 73-year-old female who subsequently proved to have a carcinoma just below the cricopharyngeal level.

In seven of the cases, some variety of obstructive esophageal lesion appeared responsible for the lodgment of a bolus which would probably have passed through a normal esophagus. Four of these patients had lye strictures of long duration; in two cases the stenosis was in association with a congenital short esophagus, and in one case the etiology of the stenosis was undetermined.

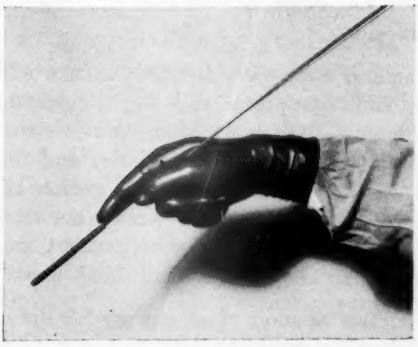

Fig. 4.—Rubber sheathed ring rotation forceps used without the esophagoscope in four cases, for removal of open safety pin in the esophagus. After the forceps has been advanced through the cricopharyngeal orifice under biplane fluoroscopic guidance, the sheath is retracted and a grasp obtained through the spring. The pin is then carried into the stomach, allowed to rotate and withdrawn with point trailing.

These cases presented no particular mechanical problem; in most of the cases piecemeal removal was accomplished through the esophagoscope by use of the fenestrated meat forceps.

In 25 cases there was a vegetal foreign body (10 per cent of the entire series). These will be considered in some detail. All of the patients except one were children, 19 of the 25 being under three years; two were less than one year of age. The various types of vegetal substance represented are shown in Table 2. The foreign body was in the trachea in 4 cases, in the right main, stem or lower lobe bronchus in 17; there were only 4 cases in which a vegetal foreign body occurred in the left bronchus.

In 22 of the cases (88 per cent) there had been a definite or strongly suggestive history of foreign body. An initial episode of choking and cough, with or without dyspnea or cyanosis, had been observed by the parents or others. In the ensuing period, cough, not always frequent or severe, was noted, but it appeared that persistent wheeze was a somewhat more constant and disturbing symptom in this interval. Appreciable degrees of dyspnea and cyanosis occurred in only four of the patients during the interval period, although these symptoms were noted initially in about half of the patients. In three cases in which the initial episode was not ob-

served, a physician was consulted because of cough and wheezing which failed to subside.

Delays in diagnosis were more frequent than would be expected in view of the obvious symptoms and the circumstances in which they had their onset. Although six of the patients were seen in the Bronchoscopic Clinic within the first 24 hours and four within the second 24 hours, the interval in 12 cases was greater than one week. Five were first seen during the second week, four during the third and one during the fourth. In one case (peanut) the interval was about five weeks, and in another (broccoli leaf) about 2½ months.

In six of the cases of more than one week's duration, the parents were responsible for avoidable delay through failure to consult a doctor. However, the first physician seen was chiefly responsible for delay in an equal number of cases, through failure to suggest an x-ray examination, or through failure to realize that a roentgen examination that is allegedly negative does not necessarily rule out the possibility of a nonopaque foreign body. In several cases, medical treatment (for pneumonia, tonsillitis or asthma) had been prescribed, and in two cases the parents had been advised to await the development of more severe symptoms before doing anything further. In five cases attempted removal of the suspected foreign body elsewhere had been unsuccessful.

The findings on physical examination of the chest were abnormal in all of the cases; this fact is of considerable importance in view of the fact that the initial roentgen examination, including fluoroscopy, was negative in two of the four cases of foreign body in the trachea and in three of the 21 cases of foreign body in the bronchus (Table 4). Wheeze was the most obvious and frequent finding in all of the cases except those in which atelectasis had occurred. In all of the tracheal cases and in most of the bronchial cases it was easily heard at the open mouth. In the bronchial cases in which wheezing was heard only on auscultation, it appeared at times that the wheeze was heard with almost equal intensity on the two sides; in these cases the associated hyperresonance and diminished breath sounds characteristic of obstructive emphysema usually allowed a prediction as to the side on which the foreign body would be found.

Appreciable elevations of temperature were infrequent except for the cases in which some degree of atelectasis had occurred. The elevations present initially usually subsided promptly following removal of the foreign body; this was true even in the case of an 8-month-old infant (bean in bronchus) whose temperature at the time of bronchoscopy was 106.6° F.

The roentgen findings in this group of cases are shown in Table 4. Obstructive emphysema of a lobe or of the entire lung was found with much greater frequency than atelectasis. Surprisingly, in 5 of the 11 cases in which obstructive emphysema was present (not having been succeeded by atelectasis) the illness was of more than two weeks' duration. Also unexpectedly, in the four cases in which atelectasis (two lobar, two entire lung) had occurred the foreign body had not been present for a long period, the average time being 3½ days. The foreign bodies in these four cases were a bean (expected to cause complete bronchial obstruction promptly because of its tendency to swell), an orange seed, a fragment of pecan, and a fragment of peanut tightly impacted in a lower lobe bronchus following previous attempted removal. It appears that the nature and the shape of the foreign body are more important than the time factor in determining whether obstructive emphysema or atelectasis is to be found.

Bronchoscopic removal was accomplished in all of the cases. In 20, removal was apparently complete at the time of the first bronchoscopy; in the other five cases, subsequent bronchoscopy, carried out after an interval of two or three days because of persistent abnormal physical or x-ray findings, showed one or more additional fragments, presumably the result of fragmentation at the time of the initial grasp. In two of the five cases in which additional fragments were removed, the interval roentgenogram had been reported negative; it appears that physical examination is equal in importance to the roentgen findings in determining whether removal has been complete, for the two patients mentioned were afebrile, essentially asymptomatic, and might have been discharged had not auscultation suggested the possibility of residual foreign body. One or more additional bronchoscopies were done for purposes of aspiration in the cases in which atelectasis had been present, with the idea of facilitating reaeration.

In one case, the first two attempts at removal of a small fragment of peanut tightly impacted in the right lower lobe bronchus were not successful. This appeared to be partially because the blades of the usual fenestrated peanut forceps were not stiff enough to create forceps spaces; a special forceps of similar construction, but with narrower and stiffer expanding blades, made it possible to grasp and remove this fragment.

Tracheotomy following bronchoscopy was required in one case (peanut shell in the trachea of a 13-month-old boy) and had been performed prior to admission to the Bronchoscopic Clinic in one

TABLE 4.

VEGETAL FOREIGN BODIES IN THE TRACHEOBRONCHIAL TREE—ROENTGEN FINDINGS IN 25 CASES

Tracheal			4
Negative		2	
Bilateral Obstructive Emphysema		2	
Bronchial			21
Negative		3	
Obstructive Emphysema		11	
Entire Lung	9		
Lobar	2		
Atelectasis		5	
Entire Lung	2		
Lobar	2		
'Partial Atelectasis' (Lobar)	1		
Emphysema and Atelectasis (Separate Lobes)		1	
Abnormal Density (Lobar)		1	

case (bean in the right main bronchus of an eight-month-old girl). In the latter case, the tracheotomy had failed to relieve the dyspnea, apparently because the obstruction was at the carinal rather than at the laryngeal level. This infant appeared moribund when first seen, with temperature of 106.6° F., grayish pallor, barely audible heart beat, feeble respiratory effort and weak convulsive movements. Oxygen was insufflated through the bronchoscope as the bean was grasped and withdrawn and the bronchoscope again introduced for aspiration and further insufflation. Although oxygen was required for the first day, there was no dyspnea or cyanosis thereafter, and the temperature subsided within 24 hours. Decannulation was possible during the third week, and reaeration of the right lung was complete by the twentieth day.

The average duration of hospitalization in the vegetal foreign body cases was 10.3 days; patients were discharged only after careful and repeated auscultation showed satisfactory aeration of both lungs,

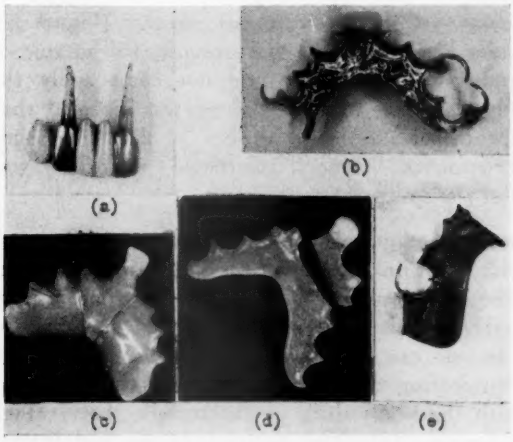

Fig. 5.—Dentures removed esophagoscopically. In one of the cases (d), the mechanical problem was simplified by cracking off a long projecting tooth with the esophagoscopic shears.

with normal temperature for at least three or four days and, in all except four cases, roentgen findings which were essentially negative. In these four cases, the residual densities seen on x-ray study were minimal and apparently resolving, although complete resolution, as determined by comparative roentgenograms made following discharge from the hospital, required considerable time (60 days in one case; 86 days in another).

In five cases dentures were the foreign body; the specimens are illustrated in Fig. 5. In two of the cases, the accident had occurred during sleep, one of the patients had swallowed his denture while celebrating his discharge from the service, and another, an epileptic, during one of her seizures.

Only one of the dentures (Fig. 5*b*) had been arrested in the cervical esophagus; three were at the level of the aortic arch, and one in the lower thoracic esophagus. As is expected from the fact that many dentures are constructed of materials which are nonopaque, there was difficulty in determining from the x-ray film the size, shape and relations of the foreign body. In one case (Figure 5*a*), two long and unusually sharp projecting roots of peg teeth were not apparent on the films, and the patient, though questioned before removal was attempted, had not been aware of their presence.

Removal was accomplished in all of these cases. Local anesthesia was employed in three cases; in one case (Figure 5*c*) the first attempt under local anesthesia was unsuccessful because of a single, long projecting tooth which would not come easily through the cricopharyngeal orifice. Esophagoscopy was repeated the following day with pentothal anesthesia, using a 12 mm. esophagoscope, and the denture removed. General anesthesia (pentothal) was also used in the case of the epileptic.

The mechanical problems, aside from those relating to the size of the object, were in protecting the projecting parts during withdrawal. The denture with the two long, sharp, projecting roots was small enough to allow rotation, bringing the points into a trailing position. In one case, the problem was simplified by cracking off the single projecting tooth and a small attached portion of plastic material with the heavy-duty esophagoscopic shears (Fig. 5*d*). In one of the dentures (Fig. 5*b*), the ends of two metallic hooks at one extremity were in such close approximation that they protected each other, preventing engagement in the esophageal mucosa during withdrawal.

There were no complications in this group of cases; the average time of hospitalization was 2.6 days.

There were seven cases of tracheal foreign body including four of vegetal foreign bodies; of the remaining three, two were wooden beads and one a rather large ovoid pebble.

Jackson[4] has called attention to the difficulties of roentgen diagnosis in foreign bodies in the trachea, and in three of the present group of cases (one peanut, one grain of corn, one wooden bead), the roentgen examination, including fluoroscopy, was reported negative. In three of the cases bilateral obstructive emphysema, the expected finding in foreign body of appreciable size in the trachea, was observed, and in the case of the pebble, the foreign body was of sufficient density to be visible in the tracheal lumen on the lateral film.

All of these patients had an obvious wheeze at the open mouth. In one of the bead cases, that of a three-year-old boy, the wheeze had been continuously present for 17 months. Tonsillectomy had been advised and performed shortly after the onset of the wheezing, and subsequently x-ray treatments were administered for a supposedly enlarged thymus, naturally without effect. Allergic studies and treatment had occupied a period of several months before the possibility of foreign body was recognized.

The audible slap and palpable thud characteristic of foreign bodies in the trachea, as described by Chevalier Jackson, were noted in four of the cases (both of the beads, the pebble, and the grain of corn).

In all, 32 of the foreign bodies (12.8 per cent of the series) were removed with guidance of the biplane fluoroscope.[3] These included 16 of the 17 open safety pins in the esophagus, as well as the four foreign bodies in the stomach (the Alnico magnet was used in removal of two of the bobette pins). The biplane fluoroscope was also used in all of the cases of pointed metallic foreign bodies in the bronchus (open safety pin, baby pin, common pin, screws, nail, tack, dental root canal reamer) and in four of the other cases of foreign body's in the bronchus (tooth cap, steel shaving, lead shot, tooth).

There were two fatal cases in this series, so that the mortality for the entire group of 250 cases was 0.8 per cent. One of the fatal cases, the only case in which tracheotomy was required following bronchoscopy for foreign body, was of a child of 13 months who had inspirated a piece of peanut shell and was first seen about seven hours later with considerable dyspnea, moderate inspiratory stridor and expiratory wheeze. Six hours following bronchoscopic removal of the foreign body (4 mm. bronchoscope; 2 minutes 9 seconds) laryngeal dyspnea had increased considerably and tracheotomy was performed after preliminary introduction of the 4 mm. bronchoscope with only partial relief of the dyspnea. While the child was being fluoroscoped about 12 hours later, a complete left pneumothorax, secondary to mediastinal emphysema, developed rapidly, and death occurred before equipment for aspiration of the pleural space could be obtained. It is possible that the pneumothorax in itself might not have been fatal, but the autopsy showed that there were, in addition, multiple areas of lobular atelectasis throughout the right lung.

The other fatal case was that of a negro male of 47 who had complained of substernal pain after eating spare-ribs about 24 hours before he was first seen. The general physical examination on admission was essentially negative except for some elevation of temperature (99.6° F.); the leukocyte count was 15,000, with 89 per cent polymorphonuclears, of which 23 per cent were nonfilaments. Although roentgen examination of the esophagus was negative, the symptoms appeared to warrant esophagoscopy. A sharp, double-pointed spicule of bone, 3.5 cm. in length, was found lying transversely at the level of the aortic arch, one extremity imbedded in

the left wall of the esophagus; the bone was removed. The temperature subsided within three days; roentgen examination five days after removal was negative, and the leukocyte count was 7,000, with 70 per cent polymorphonuclears. The patient was discharged asymptomatic on the sixth day following removal of the foreign body. Four days later he returned, having had a large hematemesis; although the bleeding apparently ceased for a few hours following his readmission, a second massive hemorrhage was fatal.

The autopsy showed a small fistulous communication between an eroded area 1 mm. in diameter in the wall of the upper portion of the descending aorta and the esophageal lumen. In this case, the presence of spontaneous perforation prior to esophagoscopy is suggested by the elevated temperature and leukocyte count on admission. The location of the foreign body was such that one of the sharply-pointed extremities was directed toward the pulsating aorta, and the pathologist suggested the possibility of pressure necrosis of a small area of the aortic wall. Clerf[7] reports three cases of esophageal foreign body in which death was attributed to pressure necrosis of the wall of an adjacent large vessel. In these cases, as in the one just described, the fatal hemorrhage occurred some time after removal of the foreign bodies (11 days after removal of a jack-stone, 12 days after removal of an open safety pin, and 36 hours following removal of a fish bone).

In none of the cases of foreign body in the hypopharynx, esophagus or stomach, except for the one mentioned above, was there permanent damage resulting from the sojourn of the foreign body or the endoscopic procedure by which it was removed. In the several cases in which a coincident esophageal lesion was responsible for lodgment of the foreign body, the prognosis does not appear to have been affected in one way or the other by the temporary presence of the foreign body.

There were, however, several cases of foreign bodies in the bronchus in which prolonged sojourn of a foreign body had resulted in irreversible changes. In one of these cases a baby pin had been present in the right lower lobe bronchial tree for 21 years; productive cough and blood streaking persisted despite removal of the foreign body, and the bronchogram showed extensive saccular bronchiectasis. Lobectomy appeared indicated and was performed, with uneventful convalescence. Lobectomy also was done in one of the two cases of broncholithiasis where prolonged obstruction had resulted in atelectasis and advanced bronchiectasis; although the bronchogram following removal of the broncholith in the other case

showed some bronchiectasis, the symptoms did not appear sufficient to require resection.

There were three other cases in which persisting abnormal density was evident on x-ray examination following removal of a foreign body from the bronchus (tooth cap in lower lobe bronchus for eight months, chicken bone in lower lobe bronchus for six weeks, and chicken bone in lower lobe bronchus for period undetermined), but these patients are essentially asymptomatic.

SUMMARY AND CONCLUSIONS

1. A series of 250 consecutive cases of foreign body in the air and food passages has been reviewed. The incidence of the common varieties of foreign body in each of the several anatomic locations, and in the various age groups, corresponds to that reported by other authors.

2. The foreign bodies most frequently encountered were bones (28 per cent of the entire series), coins (16 per cent), safety pins (13.2 per cent), vegetal foreign bodies (10.0 per cent) and meat (9.2 per cent).

3. Significant delays in diagnosis occurred in 23 per cent of the bone cases. In 20 per cent of the coin cases and in 48 per cent of the cases of vegetal foreign body, the interval preceding diagnosis was greater than one week. In only one of the safety pin cases was the foreign body "overlooked". Delays in diagnosis, when they occurred, were in many cases attributable to failure of the first physician consulted to recognize the possible presence of a foreign body or the need for roentgen examination.

4. In both of the cases in which a fragment of chicken bone occurred as a foreign body in the bronchus, several weeks had elapsed before the patients were referred to the Bronchoscopic Clinic. In one of these patients there was a strongly suggestive history of foreign body; in the other, no such history was obtainable.

5. The esophageal speculum, small size, proved to be the most satisfactory instrument for visualization and removal of coins from the cervical esophagus of children.

6. In the cases of safety pin in the hypopharynx, removal was usually by the "dangling" method. In 14 of the 17 cases of open safety pin in the esophagus, removal was by the method of endogastric version. A rubber-sheathed ring rotation forceps, used without the esophagoscope, has at times been helpful in such cases

in avoiding dyspnea (in infants and young children) from compression of the trachea by the esophagoscope.

7. Roentgen examination, including fluoroscopy, was reported negative in five (20 per cent) of the cases of vegetal foreign body in the tracheobronchial tree. Careful physical examination proved to be of great importance, not only in the diagnosis of presence and location of such foreign bodies but also in determining the presence of residual fragments following the first bronchoscopic removal.

8. Obstructive emphysema was observed in 13 (52 per cent) of the cases of vegetal foreign body in the air passages; atelectasis occurred in 4 (16 per cent) of the cases. The occurrence of atelectasis appeared to depend less on the time factor than on the nature and shape of the foreign body.

9. Tracheotomy following bronchoscopy for vegetal foreign body was required in only one case (peanut shell in the trachea of a 13-month-old boy); in one other case (bean in the bronchus of an eight-month-old girl) tracheotomy had been performed prior to admission.

10. In two of the five cases of denture in the esophagus, general anesthesia was required (pentothal sodium) for esophagoscopic removal; in one of these cases, however, the use of pentothal was thought advisable because the patient was an epileptic.

11. Biplane fluoroscopic guidance, used in 32 of the foreign body cases (12.8 per cent of the series), was particularly helpful in the cases of open safety pin in the esophagus, those of pointed metallic objects in the bronchial tree and in those of other opaque foreign bodies in the peripheral bronchi.

12. There were two fatal cases in the series of 250, a mortality of 0.8 per cent. In one of these, a child of 13 months on whom tracheotomy was required following bronchoscopic removal of a fragment of peanut shell, the terminal event was massive pneumothorax secondary to mediastinal emphysema. In the other case, a negro male of 47, death occurred from hemorrhage ten days following esophagoscopic removal of a sharp double-pointed spicule of bone lodged at the level of the aortic arch, apparently as a result of pressure necrosis of the wall of the aorta.

13. Lobectomy for bronchiectasis was required in two cases of foreign body in the bronchus because of persisting symptoms following bronchoscopic removal. In one of these, a baby pin had been present in the right lower lobe bronchial tree for 21 years; in the

other, prolonged obstruction of the right lower lobe bronchus by broncholithic material had resulted in advanced saccular bronchiectasis. There were four other cases of foreign body in the bronchus (two chicken bones, broncholith, tooth cap), in which abnormal densities persisted in the roentgenogram, but in these patients the symptoms are minimal and not progressive.

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XCI

A MODIFICATION OF THE FENESTRATION OPERATION TECHNIC

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The major problem in fenestration surgery is to keep the operatively created window permanently open. The natural tendency of injured bone to regenerate gives rise to the difficulty. This has long been recognized, and numerous attempts have been made to prevent the physiologic regeneration of bone.

The technics used in the past to inhibit regeneration of bone after the fenestration operation may be grouped in four categories. These are:

1. Other body tissues: muscle, fat,[1] and cartilage in the form of a stopple.[2]

2. Heavy metals in the form of gold leaf to cover the window,[1] and in the form of gold or lead burs.[3]

3. Mechanical maintenance of the lumen by a metal obturator.[4]

4. Better means to remove bone dust and splinters.

The technic to be reported belongs to the fourth category and has been used by me at the Johns Hopkins Hospital since May, 1946, in 76 operations.

It is well known from experience with fractures that bone dust or fragments stimulate new bone formation. This has been repeatedly confirmed in the special problem of the fenestration operation.[3, 5, 6] Bone dust or splinters unintentionally left in the region have been regarded as the major reason for the postoperative closure of the fenestra. The first consideration in my technic was, therefore, to facilitate the removal of bone dust and splinters and to prevent them from entering the perilymphatic space.

The basic principle of the new technic is to remove the bone over the window as one piece instead of pulverizing it first. The

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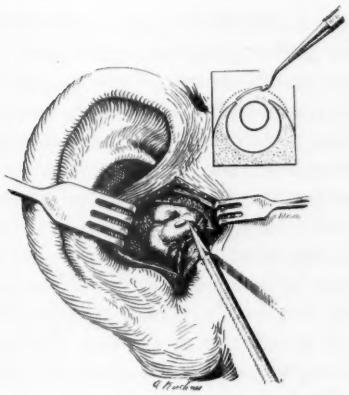

Fig. 1.

delayed exposure of the perilymphatic space and the membranous labyrinth also affords additional protection of these structures and reduces the danger of traumatic reactions (so-called postoperative labyrinthitis).

Technic. After exposure of the semicircular canals by the usual endaural approach[7] and extensive removal of the periosteal layer of the bone over the lateral canal and the adjacent part of the superior canal,[8] the endochondral layer of the lateral canal wall is resected over a wide, instead of a narrow, region. This general thinning of the bone is continued until the perilymphatic space of the canal is seen as a broad bluish line. Additional thinning of the bone is then carried out with a large polishing bur in the region of the desired window, but always with extreme care that the "window plate" is kept intact instead of being pulverized. With gentle, sweeping circular strokes of the polishing bur the "window plate" is outlined and cut in the desired size. During the whole procedure bone dust is removed by gentle irrigation with warm saline solution and with wet cotton applicators. Occasionally the last stroke of the bur lifts the whole plate out of its "frame", but this is avoided if possible, to protect the labyrinth during the next step of the operation.

The probable source of the bone splinters, as distinct from dust, which have often been observed on microscopic examination of animal material, is the edge of the fenestra. This edge,

as formed by a bur, is extremely thin and is therefore subject to being broken by the pressure applied to the graft used to cover the window. To minimize this danger, I remove the thin edge of the "frame" with dental applicators of suitable size and shape before removing the window plate itself. The applicators are cleaned after each stroke to ensure that fine bone particles are not accidentally carried into the perilymphatic space. After a blunt and firm edge has been thus created, the window plate is lifted out of the frame by means of gentle irrigation directed against the tegmen antri; the final removal is done with an excavator (Fig. 1). The tympanomeatal flap is gently but firmly pressed against the window margin with small pieces of paraffin mesh gauze. To ensure good contact with the graft, care is taken that the edges of the artificial opening are not in a depression.[8]

Discussion. The results of the 76 operations done with the modified technic during a two-year period have been very satisfactory and indicate that this technic is helpful in keeping the window open. Also, signs of postoperative labyrinthine reactions have been minimal or absent. The hearing showed, in many instances, improvement beyond the expected level.

Histologic studies of the results of operations done with this technic have not been made. The clinical results support the theoretical considerations that led to this modification of operative technic. The protection afforded by leaving the window plate intact until after all use of burs has been completed would seem not only to have helped prevent entrance of bone debris into the perilymphatic space, but also to have minimized trauma to the membranous canal and to its supporting strands of fibrous tissue.

The removal of the thinned edge of the window frame was based on observations on cadaver material, where inspection of the fenestra, after pressure had been applied to the graft, revealed minute splintering of the edge in some instances. Splintering of the edge is probably more apt to occur when the window is kept above the general level of the region than in technics where the window is in a depression. The advantage of having the window in an elevated part of the field is that the plastic can be brought into firm contact with the endosteal layer of the otic capsule. Hypothetically at least, firm pressure on this layer, which is the principal source of regeneration, should help prevent new bone formation. Certainly, regeneration does not occur when this region is submitted to the pressure of a cholesteatomatous mass.

While this paper was being written, Lempert[9] reported a somewhat similar modification of technic, in which the principle of leaving the "window plate" (called by him "bony cupola") is utilized. His method of cutting the plate differs essentially from mine, and he uses a lead bur to polish the edge of the opening after the perilymphatic space is opened. Except in the most expert hands, Lempert's method of cutting the plate with a sharp knife seems to me to involve more risk of injury to the membranous canal than does my technic. Furthermore, his technic affords more opportunities than does mine for the accidental introduction of bone debris, as well as lead particles, into the perilymphatic space. On the other hand, the risk of splintering of the edge of the fenestra by the pressure applied to the graft seems less in Lempert's technic than in mine, because the edge he creates is in a slight depression, not elevated above the general level of the region.

SUMMARY

The usual technic of making a window in the canal wall is modified by *a*) leaving the final layers of bone intact as a "window plate" except at the edge, *b*) lifting this plate as one piece after all use of burrs is completed, and *c*) removing the thin edge of the "window frame" before removal of the plate. Each of the procedures was planned to facilitate the task of keeping bone dust or splinters out of the perilymphatic space. The technic reported has been used by me at the Johns Hopkins Hospital since May, 1946. The clinical results obtained support the theoretical considerations on which the modified technic of the fenestration operation was based.

I wish to thank Dr. Stacy R. Guild for his interest in this work and for the time he has given to discussing various aspects of the problem with me on numerous occasions.

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Clinical Notes

XCII

TUBERCULOSIS OF THE MAXILLARY SINUS

REPORT OF A CASE TREATED WITH STREPTOMYCIN

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AND
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Relative paucity of clinical reports and the apparent effectiveness of streptomycin in treatment of the paranasal sinusitis of tuberculous origin prompted us to review the literature and report a case of our own.

Gleitsmann,[1] in 1907, collected 20 cases of maxillary sinus tuberculosis from the literature. Hersch[2] reported a case of a 27-year-old Puerto Rican in 1938 and collected six cases that had been reported after Gleitsman's review.

Myerson[3] states that any of the sinuses may be attacked by tuberculosis, the maxillary and ethmoid spaces being the most susceptible. He collected from the literature 27 cases of maxillary sinusitis, 10 of ethmoid, 3 each of sphenoid and the frontal sinus, and one in which all sinuses were involved. He also cites 5 cases of multiple sinusitis of tuberculous origin.

The disease is nearly always secondary to pulmonary or extrapulmonary tuberculosis which reaches the maxillary sinus by way of the blood stream or by a direct extension into the sinus. In only three of the cases reviewed did the authors feel that the lesion was primarily of the antrum. The great majority of patients were suffering from pulmonary tuberculosis. In six of the cases the maxillary sinus involvement was secondary to diseased teeth with extension into the sinus. In other cases, the disease followed lupus of the nose by direct extension. Hersh's case is a good example of hematogenous spread: the patient had tuberculosis of the spine with hematogenous spread to the antrum.

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Tuberculosis of the maxillary sinus is most commonly seen in the adult. However, tuberculosis of the superior maxilla was reported by Avellis in a child of 15 months.

Myerson lists the symptoms of tuberculosis of the sinuses as "insomnia, pain, nasal obstruction, discharge, nose bleed, nausea, vertigo, swelling of eye lids, lacrimation, slight interference with vision or blindness." These symptoms and findings may vary in degree depending on the involvement.

Medical advice is usually sought late because of the symptomless nature of the early stages of the disease. Pain is a late symptom and progresses in severity as the mucoperiosteum becomes involved. The effects of the disease on neighboring structures may cause complete nasal obstruction. Epistaxis results from involvement of adjacent vessels.

Diagnosis in an early case may be difficult. We believe, as did Gleitsmann, that more cases of tuberculosis of the antrum would be found if a more careful study of the antral washings were done by the diagnostic methods available. The chronic case is not so difficult. The symptoms are more marked, the findings more pronounced and there is an abundance of discharge which contains tubercle bacilli. The smear with the acid-fast stain, the culture and the guinea pig inoculation will certainly reveal the true nature of the diseased process if care is taken in collecting the specimen. When a biopsy is available the diagnosis is much more definite.

As for pathology, there are essentially two types to consider. The first is infection of the mucosa only. The antrum is filled with polypi and thickened mucosa which presents a boggy, pale appearance. Purulent discharge is minimal and the diagnosis may be difficult. The other type is the result of bony involvement and fistula formation. Discharge is abundant and the tubercle bacilli are readily found. Some have mentioned the hyperplastic type with the formation of a tuberculoma. The microscopic picture is that of tuberculosis found in any part of the body. Areas of necrosis are present with round cell infiltration, epitheloid cells and Langhan-type giant cells.

The prognosis depends upon the involvement. Mucosal lesions respond well to proper surgical treatment. If the bone is involved and a fistula has formed the prognosis is poor. Surgery and other methods have failed in most of the cases reviewed. A few have been apparently cured.

REPORT OF A CASE

A 32-year-old Caucasian female was admitted to the medical service of the White Memorial Hospital on July 31, 1947, with a tentative diagnosis of Cushing's syndrome and she was referred to the Department of Otolaryngology for a diagnosis and management of a left maxillary sinusitis. The chief complaints on entry were: Progressive weakness and fatigue for 18 years; insomnia, nervousness and headaches for 18 years; nasal obstruction and frequent sore throats for 15-17 years; increasing facial and abdominal obesity; hirsutism and pigmentation of the face and legs; aching and soreness in the muscles of the entire body; amenorrhea for nine years; arrested pulmonary tuberculosis; and post-nasal purulent sinus discharge for ten months following tooth extraction in February 1946.

Past History: The patient was of Russian-German extraction. She was born in Russia in 1915 and lived there for three years, following which she lived in Germany and Mexico for four and one-half years each and moved to California with her parents at the age of 12. When she was 14, the patient became aware of increasing weariness and lethargy, weakness and periodic fatigue. Breathing became difficult and she was nervous and had severe headaches which were originally in the left temple but became widespread, being prominent in the frontal and supra-orbital regions. At the age of 15 years, she had frequent sore throats and nasal obstruction interfering with breathing and occasionally shortness of breath which was attributed to the obstruction. At the age of 16 she had a tonsillectomy and adenoidectomy without apparent relief of symptoms.

In 1935 she developed bilateral pulmonary tuberculosis and she was sent to the Olive View Sanitarium, where she remained for four years. Shortly after her admission a right pneumothorax was done although the sputum was negative for tubercle bacilli. In 1938 she developed the symptoms of tracheobronchitis with considerable wheezing and paroxysms of coughing. Bronchoscopy revealed numerous ulcers in the trachea and bronchi. The ulcers were cauterized.

A left phrenectomy was done the following year. In 1940, the sputum was found to be positive for tubercle bacilli for the first time. After three months rest it was again negative, becoming positive once more in 1945, following recurrence of bronchitis.

In 1946 she had considerable trouble with poor teeth, sore throat and persistent post-nasal discharge. Purulent discharge from the left nostril was profuse. An attempt was made to remove some infected teeth about which the gums were ulcerated. On removal

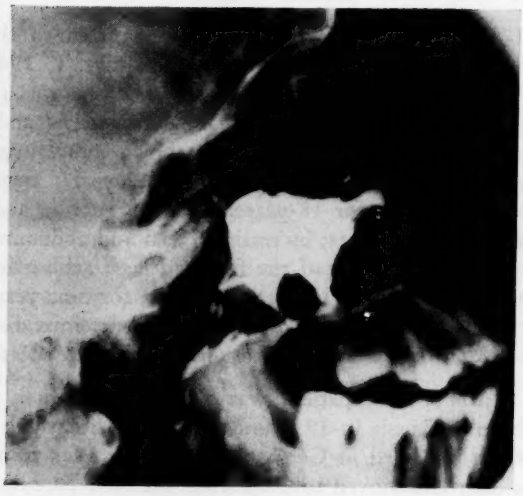
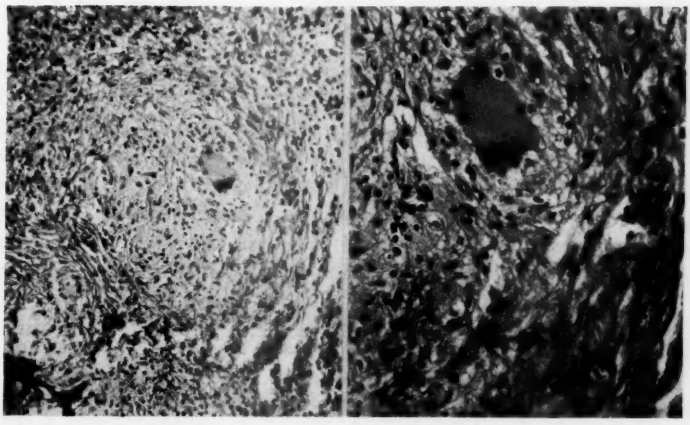


Fig. 1.

of the third left lower molar a portion of jaw broke away; this was followed by osteomyelitis of the temporal mandibular joint. In February 1946, the left antrum was irrigated on several occasions but purulent discharge persisted.

The physical examination revealed a patient well-developed and well-nourished. Her blood pressure was 140/90. The scalp was moist and hair matted. The skin of the face was oily and the face was flushed. Her pupils were equal and reacted to light and accommodation. The discs were normal and there was slight exophthalmos. Teeth were in poor repair. The gums were ulcerated, the throat slightly injected. There was purulent discharge from the left nostril, and moderate tenderness over the left maxillary sinus. There was no venous distention over the neck, nor adenopathy. Her lungs showed good expansion but the diaphragm was high on the left, probably due to previous phrenectomy. There was an impairment of resonance in both apices and decreased breath sounds in the left upper lung field. The sounds were bronchial in character in the apices. No rales were heard. Her heart was within the normal limits and the beat regular. The abdomen was obese; no masses were palpable. Some muscle tenderness was elicited in the abdominal wall as well as throughout the body. The extremities were small in pro-



A *B*

Fig. 2.—*A*, V185; *B*, X430. Tuberculosis of the antrum. Note the round cell infiltration, epitheloid cells and Langhan-type giant cells.

portion to the trunk. The left knee was larger than the right with flexion limited. The reflexes were physiological. The impression of the medical department was: (1) Cushing's syndrome, (2) acute maxillary sinusitis and (3) pulmonary tuberculosis.

Examination in the Department of Otolaryngology showed that the mucous membrane of the right nostril was congested but there was no pus. The mucosa of the left nostril was coated with yellowish-green exudate. There was a definite tenderness of the left antrum. Transillumination was much darker on the left than on the right. The tonsillar fossae were clean, but the pharyngeal mucosa was markedly reddened and there was moderate amount of purulent discharge in the nasopharynx. A diagnosis of left maxillary sinusitis was made. Daily irrigation, followed by the instillation of 100,000 units of penicillin in 2 cc. of normal saline solution was followed by rapid improvement. On the third day the force of the irrigating fluid made a channel between the antrum and the tooth socket. The x-ray of the antrum (Fig. 1) with contrasting media indicated a small oval-shaped filling defect in the posterolateral aspect of the left antrum. In addition, there was a diffuse mucosal thickening of 6 mm. in the antral wall. On August 11, 1947, a left Caldwell-Luc operation was performed. The anes-

thetic consisted of combined novocaine infiltration and nerve block and a topical application of cocaine-adrenalin solution.

The contents of the antrum were largely granulation tissue, pus, and thickened mucosa. There was a fistulous tract between the antrum and the third molar socket. This tract was closed by mobilizing a large gingival flap taken from the buccal side. A histological study of the tissue removed showed it to be tuberculous (Fig. 2). A small retaining catheter was introduced through the lower meatal passage. The patient was placed under streptomycin therapy, using 0.25 grams for two daily instillations into the sinus and 2 grams intramuscularly in four divided doses for 10 days. She showed no untoward reaction. At the end of 10 days the fistula had completely healed.

The patient was observed for four months but suddenly died of a heart attack while away from our institution. She had no symptoms referable to the sinus since our treatment up to the time of her death.

SUMMARY

A report of a case of tuberculosis of the maxillary sinus is presented.

Streptomycin was used in the treatment following surgery, both intramuscularly and by instillation into the sinus.

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XCIII

BOECK'S SARCOID OF THE NASAL VAULT

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Since Hutchinson's description in 1875 of a dermatologic form of sarcoid, a vast literature has accumulated on this clinically diverse but pathologically distinct entity. As a result of innumerable case reports it is now appreciated that sarcoidosis may involve virtually any organ or tissue in the body, and that localized manifestations, which have given rise to syndromes bearing names of individuals, are simply variations of a central pathologic theme.

Boeck's sarcoid affecting the nasal interior was apparently seen in Europe, but in this country it has been rare, very few cases having been recorded in which intranasal infiltrations were either observed or confirmed by biopsy. Novy[1] described a patient with nasal obstruction, bleeding and discharge. On examination, "The mucous membrane of the nose presented marked crusting which, on removal, showed considerable erythema. Scattered over the septum, lateral wall, and floor of the nose, there were numerous pearly discrete tumors resembling small buds of granulation tissue. They were about the size of a glass-headed pin." Biopsy disclosed the typical "hard tubercles" of sarcoid. There were similar lesions elsewhere in the body.

Kistner and Robertson[2] reported a case involving the nasal bones and underlying nasal mucous membrane with later extension to the skin of the nose. The authors did not, however, describe the appearance of the nasal mucosa.

Fletcher[3] reported a woman with no evidence of the disease other than "a reddened indurated area nearly one-quarter inch in diameter with a small ulcerated center on the septum at the mucocutaneous junction." The lesion healed following removal, and the histopathological diagnosis was tuberculosis. Upon reading Kistner's paper, Fletcher sent him a microscopic section, and Kistner replied that it might be a sarcoid. The tuberculin tests were all strongly

positive, and, prior to removal of the granuloma, had resulted in a flare-up of vestibular irritation. Although positive reactions to the tuberculin test are noted in between thirty and forty percent of reported cases of sarcoid, they are for the most part mild, and focal reactions are rare. Whether this case is or is not a true intranasal sarcoid is a matter of conjecture.

Similarly Allison and Mikell[4] described a patient with multiple sarcoid lesions associated with tuberculosis. Intranasal involvement included a large ulcerating perforation of the septum and many granulomas, but the microscopic sections of tissue from the septum showed "fairly typical miliary tuberculosis," and the diagnosis was tuberculosis. Although lesions of the skin and bones may have been diagnostic, this can hardly be accepted as an unequivocal example of intranasal sarcoid.

Longcope and Pierson[5] reviewed a series of eight cases in which sarcoidosis was widespread, and in two of them the nasal mucous membrane was presumed to be involved. However, descriptions of the intranasal lesions were meager, and no biopsies were taken.

Poe[6] presented a patient with multiple sarcoid lesions of the respiratory tract, from the external nose to the carina, proved by biopsy. Referring to the nose the author reported, "In the interior portion of the nose upon the septum of the right side . . . was a rectangular pathologic mass composed of closely packed miliary infiltrations. In appearance it could be likened to a flattened-out surface of a raspberry. It was approximately 1 cm. long and 0.5 cm. wide. In the main its surface was unbroken, but in tiny isolated spots it was covered with a crust. The patient told me that every now and then blood trickled out of her nose . . . "

Bordley and Proctor[7] reported a case of sarcoidosis limited to the left maxillary sinus and ethmoid labyrinth. Diagnosis was established by sinusotomy, and there were no intranasal lesions.

Reisner,[8] in reviewing a patient with severe and widespread sarcoidosis, referred to "a papillomatous area in the right ala nasi extending into the mucosa and causing narrowing of the orifice." The mucosal lesion was not described, and biopsy was taken from the cutaneous lesion around the ala nasi and not the mucous membrane.

So far as can be determined the above reports are the only ones in the English literature touching on intranasal manifestations of sarcoidosis, and of these some are unproved or questionable examples of the disease.

REPORT OF A CASE

A 52-year-old negress noticed progressively increasing nasal obstruction in 1914. Examination at the clinic of a local hospital disclosed an unilateral infiltrating red tumor on the septum, beginning at the level of the lower border of the right middle turbinate and extending upward out of sight. General examination revealed no cutaneous or other evident lesions. X-rays of the sinuses were negative; there were no pathologic changes in the nasal bones. X-rays of the chest suggested minimal fibroid tuberculosis with no activity. Blood count and urinalysis were normal. The Wasserman reaction was negative. Biopsy showed groups of epithelioid cells surrounded by lymphocytes; there was no caseation, and the appearance suggested either tuberculosis or sarcoidosis. Acid fast stains were negative. Three hundred roentgens were administered to the nose without improvement. In June 1945, a submucous resection and right middle turbinectomy were performed. There was an area of thickening on the left side of the septum similar to that on the right, but the mucous membrane elevated easily beneath the infiltrations. A final diagnosis of Boeck's sarcoid was recorded.

The patient then dropped from sight until 1947, when she consulted one of us (DHK) because of slowly progressive swelling of the right fifth finger of two years' duration. She was referred for nasal examination (HJR) because of the complaint of obstruction. Findings were such that her previous hospital record was checked, and she was admitted to the Los Angeles County Harbor General Hospital in Torrance for observation.

There had been considerable change in the intervening three years. A mild puffiness extended from the nasal bridge to the left upper and lower eyelids, and the skin here was thick to the touch and of a reddish hue. Medial to the inner canthus was a 1 cm. square, darkly pigmented spot. The nasal mucosa was crusted and atrophic, and slight manipulation induced bleeding. The septum was greatly thickened. Inferiorly its mucous membrane seemed only atrophic, but as the septum expanded superiorly to lose itself in the nasal vault, it assumed a distinctly tumorous aspect. The mass was dull red, non-tender, very firm, lightly crusted, and studded with minute uniformly sized semitranslucent nodules. It fused with the anterior half of the left middle turbinate and was so wide that its upper limits could not be seen. The nasopharyngoscope was passed with difficulty and revealed no abnormalities in the posterior halves of the nasal chambers other than generalized thickening of the septum. X-rays of the nasal bones showed areas of erosion. The entire prox-

imal phalanx of the right fifth finger presented a hard nontender fusiform enlargement which interfered with flexion. X-rays of this finger showed, beside marked soft tissue swelling, extreme porosis of the cortex, widening of the shaft, and multiple varying sized cyst-like areas of rarefaction in the proximal phalanx. In the middle of the shaft laterally the cortex was perforated, and at this point there was a circumscribed ossifying periosteitis. The other phalanges in both hands were normal. The chest x-ray was within normal limits. The Kahn reaction was negative. Red cell count was 4.5 million; hemoglobin 13 grams; white cell count 6800 with 69% polymorphs, 27% lymphocytes, 2% eosinophils, and 2% monocytes. Sedimentation rate was 15 mm. in one hour (Westergren). Urinalysis was negative. Serum protein was 6.5 gm. per 100 cc. of serum, and the A:G ratio was 4:2.5. The tuberculin test was negative. Spinal fluid cell count and chemistry were within normal limits.

The pathologist reported that biopsy of the intranasal tumor showed "clusters of tubercle-like nodules without central caseation. The tubercles contain epithelioid cells, fibroplastic elements, and round cells. Diagnosis: chronic granuloma, consistent with sarcoidosis." No lesions suggestive of the disease other than those of the nose and hand were detected on general examination.

Over a period of 24 days the patient received 44 grams of streptomycin. This affected no apparent change in her condition, and although further treatment was urged, she felt it imperative to return to work and signed herself out of the hospital. One month later her complaints and appearance were the same.

It would be difficult to imagine two parts of the body less logically and less frequently sharing the same disease process than the nose and the phalanges. Yet that very feature in this case best illustrates the bizarre nature of Boeck's sarcoid. Although lymph nodes, lungs, skin, and bones are statistically most often involved, any tissue may be, and possible combinations are endless. The literature abounds with case reports which bear no clinical resemblance. Sharply circumscribed cyst-like areas of rarefaction in the bones of the hands and feet, so confusing by themselves and identified at one time as Jüngling's disease, are now recognized as components of sarcoidosis. The phalangeal lesions in this patient are typical.

Laboratory findings of presumed significance include elevation of the blood proteins—notably the globulin fraction, increase in monocytes and eosinophils, and an elevated sedimentation rate. None of these was noted in this patient.

From the few cases well described in the literature there would seem to be no striking uniformity in the gross appearance of intranasal sarcoids other than a tendency to crust and bleed. This case is unique in that the disease appeared on the nasal septum and did not manifest itself elsewhere for several years. The granuloma slowly extended upward and forward to infiltrate the nasal bones and overlying skin. Absence of visible lesions at present in all but the nose and one finger is no indication of the future course of the disease. Whether it will remain stationary, progress, or resolve cannot be prognosticated with the least accuracy by any known method.

So far as is known, this is the first report of treatment of sarcoidosis with streptomycin. There was no significant response to the intramuscular administration of 44 grams.

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XCIV

DEATH FOLLOWING BRONCHOGRAPHY

REPORT OF A CASE

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B. H. L., a two year old boy, was admitted to the North Carolina Baptist Hospital on January 26, 1947, and died February 4, 1947. He was sent in with a chief complaint of cough, asthma and frequent attacks of severe difficulty in breathing. At four weeks of age he had developed a deep chest cold, nasal discharge and rattling in the chest. He never completely recovered from his cough and at ten months of age developed a high fever with a more severe cough. A diagnosis of bronchopneumonia was made. There was an associated diarrhea.

Following this acute illness a hacking cough persisted. There were attacks of inspiratory and expiratory distress. A diagnosis of allergic bronchitis and bronchial asthma was made and he was sent to an allergist, who found him to be sensitive to dust, wheat, and rice. An elimination diet and vaccines were used with slight improvement: less cough and wheezing, and some gain in weight.

On December 31, 1947, he developed marked respiratory distress and was admitted to a local hospital. The temperature was 100.4° F., and there were many whistling rales throughout both lungs. The respiratory distress was present on inspiration and expiration and was not affected by epinephrine given hypodermically. He improved after a few days of penicillin therapy and went home on January 6, 1947. At the time of discharge he was still wheezing, but the temperature was normal. His symptoms returned, however, and he was again admitted to the same hospital on January 25, 1947. The temperature was 103.0° F., the white blood count was 33,000 with 84% polymorphonuclears, 4% eosinophils, and 12% lymphocytes. A roentgenogram of the chest showed a dense

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shadow at the right hilum. The patient was given penicillin intramuscularly and the next day, January 26, was sent to this hospital.

Physical examination: The temperature was 100° F., pulse 100, respirations 110, and weight 24 lbs. The child was poorly nourished, poorly developed and appeared chronically ill. The skin was pale. Cervical, axillary, inguinal, and epitrochlear lymph glands were palpable. The head was large and the fontanelle was closed. Catarrhal changes of both tympanic membranes and a mucoid anterior and posterior rhinorrhea were observed. The lungs presented moist and dry rales audible over the entire chest on inspiration and expiration. No wheezes or change in percussion were noted. The heart was not enlarged and the rhythm was regular. The abdomen was negative. No clubbing of the extremities was noted. A roentgenogram of the chest on January 30, 1947 (Fig. 1) showed a nonspecific pneumonitis in the right base. The heart, great vessels and diaphragm appeared negative on fluoroscopy. There was an increase in the bronchovascular markings, especially extending into the cardiophrenic angle. Urinalysis was negative. The white blood count was 17,680 with 58% polymorphonuclears, 2% eosinophils, 1% basophils, 35% lymphocytes, and 4% monocytes. The red blood count was 3,950,000. The hemoglobin was 12 grams. Corrected sedimentation rate was 54 over 41. The hematocrite was 36 volumes per cent. The Kahn test was negative. No parasites nor ova were demonstrable in the stools. The tuberculin patch test was negative. No acid fast bacilli were found in the sputum.

Course in hospital: The rectal temperature remained below 100.4° F. until the fourth day when it went to 103.0° F. Penicillin, 80,000 units daily, was started. The temperature dropped to 100.0° F., but was up to 100.8° F. on the seventh day. The temperature was down to 99.0° on the ninth and tenth hospital days.

On the tenth day, without anesthesia a four-mm. bronchoscope was passed into the trachea with the aid of a laryngoscope. Nothing abnormal was noted except a mild hyperemia of the trachea and main bronchi. Secretions were minimal and of a clear mucoid character.

The light carrier was removed, leaving the tip of the bronchoscope just above the carina. Ten cc. of iodochloral was injected through the carrier channel of the bronchoscope. After half of the oil had been injected the child became somewhat cyanotic for a period of 40 seconds. This rapidly subsided and the remainder of the oil was injected. The color of the patient remained good. The

bronchoscope was removed and he was placed in various positions to fill all lobes. The patient was cooperative and showed no signs of breathing difficulty. He was taken to the x-ray department where roentgenograms were made. The bronchial tree was well filled with oil except in the upper lobes. There was no evidence of abscess or bronchiectasis (Fig. 2). The child was returned to his room apparently in good condition.

Fifteen minutes later, or 30 minutes after the instillation of the oil, the boy became cyanotic very rapidly, cried out and developed convulsive movements of all extremities. Respiration became rapid and labored. Marked retraction of the sternum and interspaces was present. No air could be heard entering either side of the chest. The muscles of mastication became spastic while attempts were made to introduce a laryngeal airway between the teeth. Intranasal oxygen was started and the cyanosis became slightly less intense. A tracheotomy was done immediately, but the heart had ceased beating before the trachea was opened. Despite artificial respiration, oxygen, and an adequate airway through the tracheal opening, the child could not be revived. There was no secretion in the trachea. Coramine given intramuscularly and epinephrine by intracardiac injection were of no avail. The child was pronounced dead 45 minutes following the iodized oil instillation.

The autopsy revealed no free fluid nor adhesions in the pleural cavities. The heart was opened under water and contained no oil nor air. No thrombi were present in the pulmonary vessels. Both lungs were pink and homogeneous. The left lung weighed 100 grams, the right 125 grams. No obstruction was found in the larger bronchi. Microscopic sections of the right lung showed considerable atelectasis. The alveolar septa were thickened. Within the lumen of the small arteries was a rather marked polymorphonuclear reaction, out of proportion to the number of red cells present. Within the vessels was a homogeneous pink staining material. Some perivascular reaction with many plasma cells and eosinophils was seen. Fat stains of tissue from the right lung revealed numerous red staining globules in the small bronchi and alveoli, sparsely scattered throughout the tissue. No fat was seen in any of the blood vessels. The left lung showed a moderate amount of pink staining material in the alveoli which was interpreted as edema. There was some peribronchial reaction consisting mainly of small round cells. Within the bronchi and alveoli were large mononuclear cells containing red staining fat. The trachea presented minimal edema. The brain sections revealed no abnormalities. Fat stains were done and no fat

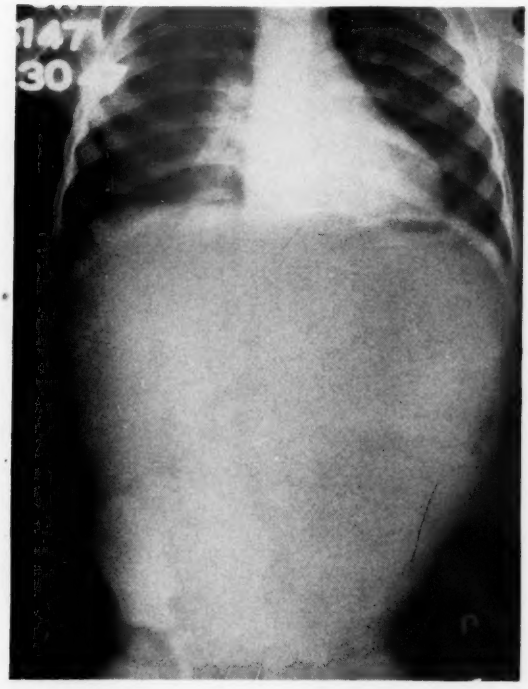

Fig. 1.—Chest film revealing nonspecific pneumonitis in the right base.

was seen in the brain tissue or vessels. Sections through the cervical portion of the spinal cord were not revealing. The pancreas was normal. Final diagnosis: bilateral peribronchiolitis; interstitial pneumonitis; congestion of the kidneys; congestion of the spleen; and tracheotomy.

Numerous complications resulting from instillation of iodized oil into the tracheobronchial tree have been reported. Some of these complications occurred within 24 hours; others were delayed. There were fatal and nonfatal cases in each group.

Lipiodol is 28% iodine in poppy seed oil. The iodine is said to be in chemical combination with the oil. This combination breaks up slowly once the oil is in the body, but it is otherwise fairly stable.

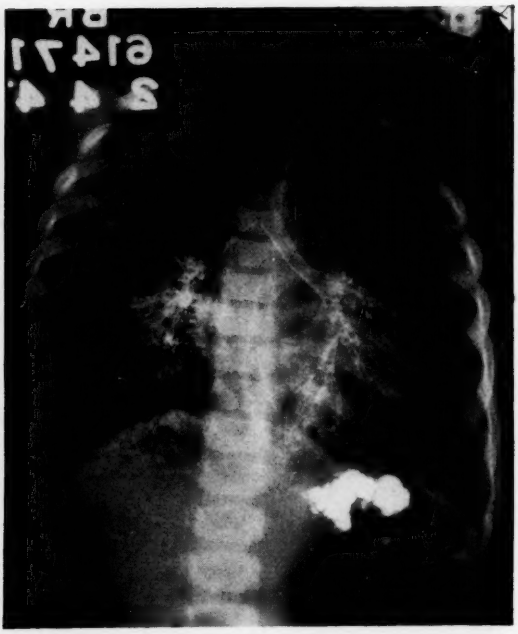

Fig. 2.—Bronchogram showing no evidence of abscess or bronchiectasis. Note iodized oil in stomach.

Iodochloral contains 27% iodine and 7.5% chlorine in organic combination with a highly refined peanut oil. Both preparations are believed to be free from irritation.

Knipping and Ponndorf[1] observed no significant absorption of iodine from the lungs of man or animals. Sicard and Forestier[2], however, have shown that absorption of iodine from the bronchial tree is nearly as great as from the gastrointestinal tract. Despite these contrary findings, it is generaly agreed that iodine is absorbed from swallowed oil during its passage through the intestinal tract. An iodine sensitivity must be considered.

Amberson and Riggins[3] feel that lipiodol possibly acts as a mild irritant in the tracheobronchial tree, exciting a reaction with edema. Another explanation offered by them is that a severe bronchial and bronchiolar spasm may expel air from the lung and result in atelectasis.

MacDonald[4] reported the case of a 13-year-old girl who developed nausea and vomiting after a bronchogram. She became cyanotic with a gradual diminution of pulse pressure. Respiration ceased 20 hours following instillation of the oil. The patient had a history of asthma since early childhood. Sensitization tests were positive for a large number of animal, food, protein, and bacterial substances. Asthmatic attacks were frequent and distressing. Autopsy revealed a tenacious mucous exudate in the larger bronchi. The lungs showed edema. A tough fibrinous membrane formed a cast extending into the bronchi of the second order. A mucopurulent exudate was in the larynx and trachea. Muscular hypertrophy and eosinophile infiltration were observed in the intermediate bronchi. It was the author's opinion that death possibly resulted from some form of an allergic reaction to the oil.

Amberson and Riggins[3] cite Singer's case of a man with carcinoma of the right lower lobe bronchus. The patient developed shock, tonic and clonic convulsions, intense cyanosis, dyspnea and unconsciousness following a bronchogram. He died a number of hours after instillation of the oil. The exact interval was not given.

The same authors report the death of a 64 year old man immediately after instillation of the oil. The patient had a history of hay fever, sinusitis, rheumatic fever, and heavy alcohol consumption. There was wide spread pulmonary fibrosis and emphysema. The heart was enlarged to the right and the sounds were distant. Ten cc. of lipiodol were instilled into the trachea. The patient was placed before the roentgenoscope and in a few minutes collapsed. He developed cyanosis, dyspnea, and a feeble pulse, dying within the hour.

McMahon[5] reports the case of a 41 year old male who expired 75 minutes after the instillation of 20 cc. of lipiodol into the tracheobronchial tree. There was no definite history of asthma. Twenty minutes after the oil injection the patient had a convulsion, became cyanotic, and was pronounced dead after 7½ grains of sodium amytal administered intravenously failed to halt the reaction. Autopsy revealed the tracheobronchial tree to be full of thick tenacious mucus. The lungs appeared atelectatic. Microscopically the bronchiolar walls and peribronchial tissues were heavily infiltrated with eosinophils. Atelectasis was not complete. The coronary and pulmonary vessels were patent and free of thrombi. The author felt that death was probably due to iodine sensitivity.

Pendergrass, Chamberlain, Godfrey, and Burdick[6] surveyed deaths and unfavorable sequelae following the administration of contrast media. Attention is drawn to 37 deaths from the use of various contrast substances. Eleven of these deaths had been reported previously. All were from intravenous injection of the dye except one, which was from injection into the ventricles of a hydrocephalic, and another resulting from an intraspinal injection. Many of the 17 sudden deaths had preceeding symptoms suggestive of anaphylactic shock.

J. G. Scadding[7] reported the first death he had seen in 2900 lipiodol examinations. He had, however, seen transient urticaria, coryza, lacrimation, and submaxillary gland swelling on several occasions. The fatality was in a 64 year old male with bronchographic evidence of a bronchiectatic abscess in the right upper lobe. He developed coryza, nose bleed, salivation, and conjunctival injection. The tongue was swollen as were the submaxillary glands. A generalized urticaria, marked dyspnea, and rales in both lungs were present. There was no improvement on saline purge, adrenalin, atropine, and sodium thiosulfate given intraveneously. Death occurred 54 hours later. Autopsy revealed extensive hemorrhages in the visceral pericardium, small hemorrhages in the mycardium, congested air passages, large petechiae in the mucosa of the trachea and larynx, edema of the epiglottic folds, marked bronchitis, and a cavity in the right upper lobe. The base of each lung was congested and edematous. A small hemorrhage was present in the liver. There were cloudy swelling of the kidneys and hemorrhages into the mucous membranes of the intestines and beneath the capsule of the submaxillary gland. A roentgenogram revealed no lipiodol in the patient's stomach.

Archibald and Brown[8] report few details on a patient who died 5 days after filling the left lung with lipiodol. Autopsy revealed lobar pneumonia on the left, pulmonary tuberculosis in the right apex with cavitation, and bilateral fibrinous pleurisy.

Goldstein[9] reports a case of fatal ioderma 26 days after a bronchogram. A papulopustular eruption appeared the morning after injection of the oil. The rash started on the face and forehead, gradually spreading over the chest and extremities. The patient became stuporous with marked edema of the tongue and numerous hemorrhage areas. The urine revealed the presence of iodine and albumin. Hyaline and granular casts and a few red cells were seen. The skin lesions progressed and covered the entire body before death.

Fatal iododerma is reported by Hollander and Felterman[10] following medication with various drugs containing iodine. Ten fatal cases reviewed died from 7 to 120 days after the onset of symptoms and one case lived for over a year.

Amberson and Riggins,[3] in discussing the occasional rapid spread of pulmonary tuberculosis after intrabronchial lipiodol, present the case of a 31 year old negress. She had tuberculous infiltration and several small cavities in the upper and lower quarters of the left lung, and fibrosis in the right base. The sputum contained tubercle bacilli. A roentgenogram taken seven weeks after lipiodol instillation mainly into the left lung, showed an increase in the tuberculous process in the upper third of the left lung and oil retained in the middle third of the left lung. Lipiodol was again instilled at that time and two weeks later a roentgenogram revealed oil still present in the lower two thirds on the left. Four days later she was greatly prostrated, nauseated and suffering respiratory difficulty. The temperature rose to 103.0° F. A roentgenogram showed a rapid spread of the tuberculous infiltration in the middle third of the left lung in the region of the oil retention. She died 6 months after the first oil injection. These authors also report instances of bronchiectasis and pneumonitis in which lipiodol instillation was a factor in aggravating the suppurative process and precipitating death.

Nonfatal acute iodism after bronchography is reported by numerous authors. Most of the transient symptoms observed by various writers have been seen after bronchograms, occasionally in this hospital. Bayliss and White[11] had a 32 year old female who noticed a sore throat and painful neck some 24 hours after a bronchogram. Edema of the glottis, tongue and face appeared. An urticarial swelling, marked dyspnea, a temperature of 102.0° F., a pulse of 160 and a bullous rash with petechial hemorrhages developed. She was well in two weeks. She had had a previous bronchogram four years before without ill effects. The authors felt that the iodine in the oil was responsible since similar cases following the administration of 25 grains of potassium iodide have been known. After recovery, in this patient skin tests with iodine were all negative. The author quotes Robinson as stating that, "There is no way to determine a patient's idiosyncrasy to iodine before a lipiodol examination."

Ingersoll and Robbins[12] discuss oil embolism following the injection of iodized oil into the uterine cavity and tubes. They review a fatality of Gajzago in a 60 year old woman who went into shock soon after injection and died nine hours later. Autopsy showed oil emboli in the lungs, heart and kidneys.

These authors report the case of a 43 year old woman, who had 5 cc of iodized oil injected into the uterine cavity. Roentgenograms revealed oil in the vessels outside the uterus. The next day she had a "queer" feeling in her chest, and the following day there was deep pain in each side of her chest. A roentgenogram showed patchy densities which were taken to be infarcts in each lung. There was fluid in each pleural space. She made an uneventful recovery.

Two cases of fatal oil embolism are reported by Patterson[13] following the injection of 20 cc. of petrolatum into the urethra to dilate a stricture. One patient, a 61 year old male, died seven hours afterwards. Dyspnea and cyanosis appeared immediately after the injection and persisted until death. He developed a left hemiplegia after the onset of symptoms. At autopsy droplets of oil were demonstrated in the capillaries of the lungs and kidneys with Sudan III stain. The oil was found in large amounts, diffusely scattered throughout the lungs. No oil was found in the brain.

The diagnostic value of iodized oil in the bronchial tree is no longer questioned. A careful and accurate mapping of all lobes of the lungs in bronchiectasis is indispensable to the complete eradication of diseased areas with the least number of operative procedures. However, bronchography is not an innocuous procedure. There are contraindications to filling the bronchial tree with a material which may be harmful on decomposition. Too great a volume of oil must be avoided because of the danger of obstructing the bronchi. This is particularly applicable to children, in whom a slower injection is required due to the relatively smaller size of the bronchi. The local irritating effect of the halogens, in combination with the oil, produces edema and smooth muscle spasm. Again, the ever present possibility of individaul idiosyncrasy to iodine and the substances in the oily base must be remembered.

Although the mechanism of death in many of the fatalities immediately after bronchography is not known, the presence of a hypersensitivity to some constituent of the iodized oil is thought to exist.

An acutely ill patient and demonstrable areas of pneumonitis are contraindications to bronchography. Management of these people should be directed toward clearing up as much of the acutely involved area as possible and postponing oil studies for sometimes weeks or months.

The high incidence of respiratory allergy in patients with bronchiectasis means that the greater number of bronchograms are being

done on individuals with an already known hypersensitivity to many agents.

Precautions to be taken include the immediate availability of bronchoscopic means of removing the injected oil. The patient will usually have collapsed before coughing up much of the oil. Oxygen must be administered through the bronchoscope and under positive pressure. The stomach should be washed with salt solution if a roentgenogram reveals swallowed oil. Barbiturates may be administered intravenously for convulsions, adrenalin intramuscularly for its effect in the allergic reaction, and respiratory stimulants as indicated.

By observing these precautions we believe that a small number of serious postbronchographic accidents have been avoided.

SUMMARY

1. The death of a two-year-old boy 45 minutes following the making of a bronchogram is reported.

2. The cause of death is thought possibly to have been an iodine sensitivity.

3. A review of the literature reveals other fatal and nonfatal reactions following the instillation of iodized oil into the tracheobronchial tree.

4. In making a bronchogram, certain precautions must be taken to guard against respiratory embarrassment in cases of sensitivity.

5. There is, so far, no known test to predetermine sensitivity to iodized oil.

BOWMAN GRAY SCHOOL OF MEDICINE.

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XCV

METASTATIC CARCINOMA OF THE MASTOID, FOLLOWING CARCINOMA OF THE PROSTATE

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Metastatic carcinoma of the mastoid is such an extremely rare condition, that any proven case merits reporting. Rubin,[1] in 1936, reported a case of metastasis to the petrous apex following carcinoma of the breast. Dart[2] states there is no case of metastasis to the mastoid on record in the files of the Army Institute of Pathology.

CASE REPORT

A 50-year-old white male, was admitted to Bath Veterans' Administration Hospital on February 27, 1948, for treatment of pain and deafness in the right ear, and right facial paralysis. On January 13, 1948, impacted cerumen had been moved by irrigation from the right ear canal. On January 15, 1948, he began to have pain in the right ear and noticed, at the same time, diminished hearing in that ear, both of which persisted to the time of admission. He noted no discharge from the right ear. On February 15, 1948, he awoke in the morning to find the right side of his face paralyzed. He also complained of pain in the back.

Previous History. Before January 13, 1948, he had never had any ear trouble other than impacted cerumen.

In September, 1947, a clinical diagnosis of carcinoma of the prostate, with metastases to the pelvis, was made at this hospital. He was transferred to the Tumor Center of the Veterans' Administration at Bronx, New York, prescribed stilbesterol and discharged to his home.

His family history was negative.

Physical examination: Hearing, right ear: conversational voice was heard at 1 foot; whispered voice was not heard. The Rinne test on the right was negative and the Weber test lateralized to the right.

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There was marked tenderness of the right mastoid tip. There was no edema nor swelling over the mastoid. The right canal contained some thick debris, with a slightly foul odor. On cleaning the canal, there was some bleeding. The inner third of the canal wall was edematous. The drum was thickened, but not bulging, and mildly injected. The left ear was normal.

He had a complete right facial paralysis. The liver was palpable five fingers down from the xiphoid process. It was stony hard, nodular, and moderately tender. The prostate was enlarged, indurated, stony hard and not movable; the median sulcus was obliterated. The inguinal lymph nodes, slightly enlarged bilaterally, were discrete, firm, and not tender.

The temperature was normal. Laboratory findings: white count, 9,300, with normal differential; red count, 4,000,000; hemoglobin, 78%. The Kahn test was negative; icteric index, 23; total protein, 7.2; albumen, 5.4; globulin, 1.8.

An x-ray of the mastoids made on February 3, 1948, showed a large defect in the right mastoid which appeared to involve the antrum. There were no cells evident in this rather sharply outlined area. Metastatic carcinomatous lesions were apparent in the right frontal bone, the fifth left rib, both mid-lung fields, the pelvis, the first, fourth and fifth lumbar vertebrae, the twelfth dorsal vertebra, and the upper third of the right femur.

Course in hospital: In view of the afebrile course, the absence of discharge from the right ear, the absence of swelling of tissues over the mastoid, and the presence of widespread metastases to the skull, lumbar spine, pelvis, liver and lungs, it was believed that the mastoid lesion was also metastatic carcinoma, and inoperable. At no time did patient present any evidence of mengingeal involvement, nor complain of dizziness.

A bilateral palliative orchidectomy was performed on March 3, 1948, which gave the patient considerable relief from pain. Stilbesterol was administered daily in 5 mg. doses. His course was gradually downhill and he expired on March 23, 1948.

Pathological report: Primary carcinoma of the prostate. The petrous and mastoid portions of the right temporal bone were found to be destroyed by malignant tumor tissue. The bone appeared moth-eaten and broken down, and liquefaction was quite prominent.

Histologically, sections showed the mastoid and petrous portion of the temporal bone to have undergone osteolytic changes and to

be diffusely infiltrated by a metastatic carcinoma. The bone and tumor fragments stained rather poorly as a result of the necrosis present, but the general pattern of the tumor could still be recognized. In addition, there were metastases to both lungs, the left ribs, the liver, the lumbar spine, the skull and the pelvis.

VETERANS' ADMINISTRATION CENTER.

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XCVI

INFECTIOUS MONONUCLEOSIS AND AGRANULOCYTOSIS

REPORT OF A CASE

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The coincidence of infectious mononucleosis and agranulocytosis is sufficiently unusual to merit reporting. It is particularly worth noting in view of the many cases of infectious mononucleosis in which granulocytopenia, but not agranulocytosis, is present at some phase of the disease. The fact that agranulocytosis does sometimes occur in conjunction with infectious mononucleosis is sufficient reason to consider agranulocytosis, not only in the original differential diagnosis, but during the subsequent course of the disease, as the case reported in this paper illustrates. Agranulocytosis must especially be kept in mind when the sulfonamide drugs are used to treat infectious mononucleosis.

In a review of cases of infectious mononucleosis at this clinic, one of us (J. E. S.) found a case of agranulocytosis as a complicating feature in 210 cases of infectious mononucleosis (nonepidemic). Wechsler, Rosenblum and Sills[1] noted the incidence to be 1 case in a total of 556 cases (although in 3 other cases there were very low granulocyte counts). Otherwise, reports of the simultaneous occurrence have been made only sporadically and without reference to a series.

Infectious mononucleosis is a disease entity now widely recognized by the alert physician among the large variety of acute febrile illnesses encountered in the practice of general medicine, pediatrics and otolaryngology. Historically, there is considerable confusion over who first recognized the disease. Pfeiffer[2] originally described "glandular fever" in 1889. In 1907 Türk[3] reported a series of cases of seemingly acute leukemia, in which the disease had a benign course and terminated in recovery. Sprunt and Evans[4] in 1920 reviewed

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the literature and added data on several cases of their own. They gave the name "infectious mononucleosis" to the condition. Longcope[5] in 1922 gave a more adequate description of the peculiar cytologic picture of the disease, calling attention to the fact that the characteristic cells of the disease are atypical lymphocytes. Downey and McKinlay[6] in 1923 described the more intimate histologic details and classified them. The characteristic serologic phenomenon of the disease, the Paul-Bunnell heterophil antibody reaction, was accidentally discovered and described in 1932.[7] In 1935, Nolan[8] reported that infectious mononucleosis could produce a false positive Wassermann reaction.

Agranulocytosis was first described as a clinical entity by Schultz[9] in 1922. Since that time the condition has been extensively reported, and many chemical agents have been indicted as etiologic factors. The relationship to acute infection is as yet not entirely clear; namely, whether agranulocytosis can be produced by severe infection or whether the severe infection results from the agranulocytosis caused by an unknown agent.

Infectious mononucleosis is an acute febrile disease characterized by a lymphoid reaction producing the atypical lymphocytes in the lymphatic tissues and peripheral blood stream. No animal or bacterial organism has been successfully implicated as the etiologic agent, although accusing fingers have been pointed at various streptococci, Vincent's organisms, Toxoplasma, the influenza bacillus, and Listerella monocytogenes.

The characteristic lymph node shows hyperplasia of the lymphoid reticulum and germinal centers, often to the point of distorting the nodal architecture. Many of the lymphocytes are atypical. These invade the peripheral blood stream but may do so variably and not constantly.

The reticulum of the bone marrow does not undergo lymphoid metaplasia. The marrow may be normal or show mild myeloid hyperplasia. When the atypical lymphocytes are found in samples of bone marrow aspirate, we believe their occurrence to be due to aspiration of sinus peripheral blood or of cells from the small accumulation of lymphocytes that occur in the bone marrow normally.

The recognition of the "atypical lymphocyte" is of paramount diagnostic importance. Downey and McKinlay[6] have described these as follows: Type I is a large lymphocyte with vacuolar or foamy cytoplasm. The nucleus is oval or slightly lobulated. The nuclear pattern is coarse and the chromatin strands present poor differentiation

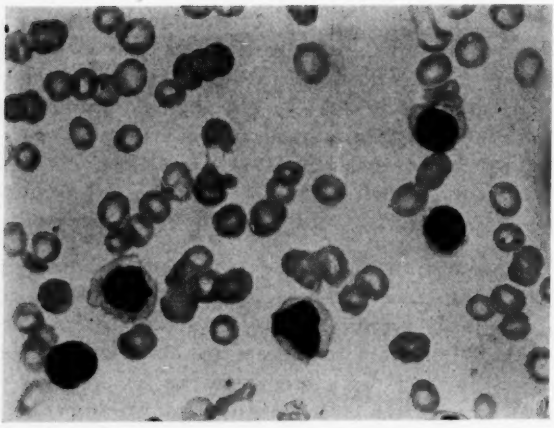

Fig. 1.—Sternal marrow during height of the agranulocytosis, showing marrow lymphocytes (x800).

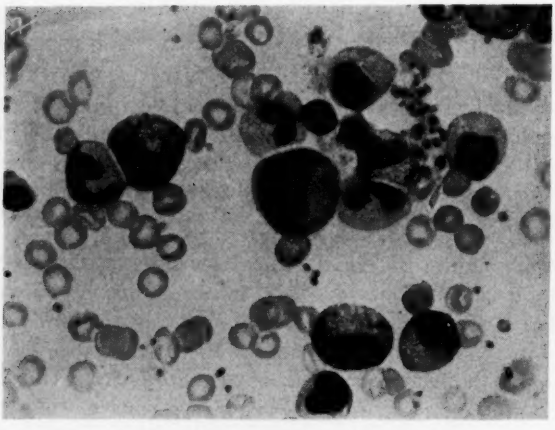

Fig. 2.—Sternal marrow aspirate during recovery phase after agranulocytosis (x800).

from the parachromatin. In the type II cell, the cytoplasm is abundant and homogeneous. The nucleus is finer and often vacuolated. The principal feature of the type III cell, in distinction from the other two types, is the nucleus, which has many features of cellular immaturity such as the fine chromatin pattern and nucleoli. This type of cell may present diagnostic difficulties, as it resembles lymphocytes seen in some types of acute lymphatic leukemia. When these are found, recourse to heterophil antibody titration, sternal aspiration and clinical observation may be necessary to enable one to distinguish the process from leukemia.

The large size of the cell and the lobulated, deformed character of the nucleus have given rise to the term "leukocytoid lymphocyte." All types of cells may be found in a given case, although usually one type predominates. No correlation has been noted between the cell type and the form or severity of the disease.

Unequivocal diagnosis of infectious mononucleosis depends on the demonstration of the heterophil antibody titration and the finding of the atypical lymphocytes. At times these criteria may be difficult of fulfillment, as the heterophil titration and the presence of the characteristic cells may be transitory. Early in the disease there may be neutrophilic leukocytosis, which later is followed by relative lymphocytosis. Serial observations are thus necessary when the disease is suspected but not proved. Rarely, recourse must be had to sternal aspiration or biopsy of a lymph node.

Later in the disease granulocytopenia may occur but, as noted previously, agranulocytosis is rare. However, it must always be kept in mind that the morphologic picture can show considerable variation.

Clinically, infectious mononucleosis may be variable. It may simulate many other diseases, such as acute tonsillitis and other acute pharyngitides, the lymphoblastomas, acute leukemia, infectious hepatitis, meningitis, and even acute appendicitis. The disease may be very mild or very severe.

The incubation period is probably 11 to 14 days. The disease is thought to be moderately infectious, its victims frequently being medical students or laboratory workers, but it is not highly contagious. The onset is variable; there may be a period of mild malaise followed by apparent recovery, only to be followed by the full flowering of the disease. Lymphadenopathy may precede the fever by weeks. There is no seasonal incidence.

The course of infectious mononucleosis is not well known. Once the diagnosis has been established and the acute phase has subsided,

follow-up studies are unusual. There is some suspicion that a smouldering form of the disease may exist for months. One of us (C. F. S.) has noted atypical lymphocytes present in the peripheral blood nine months after clinical recovery.

Various classifications of the forms of infectious mononucleosis have been advanced. These are based on the main presenting signs. The usual classification has given "glandular," "anginose" and "febrile" as the "types" of the disease, but any given case may cut across the classificatory lines. Walker[10] has conveniently grouped the various manifestations as follows: 1. The respiratory symptoms include the sore throat, cough, thoracic pains and sore mouth. 2. Febrile: The fever may be low-grade, hectic or high-sustained. On the other hand, the disease may be afebrile. 3. Lymphadenopathy: In some cases these may be marked generalized adenopathy, but in other cases the involved nodes may be beyond the palpating fingers. Adenopathy occurs acutely and subsides slowly. The nodes are firm and discrete, never fluctuant. The cervical nodes are most commonly noted. Splenomegaly of mild degree is a highly frequent finding. The longer and more carefully a patient is studied, the more frequent will be the finding of an enlarged, nontender spleen. Splenomegaly was present in 25 of Walker's series of 29 cases. 4. Exanthems: In some epidemics an eruption may be a common feature. The type of rash is variable when it occurs. 5. Nervous: In some cases headache, nystagmus, dizziness, diplopia or meningismus is present. 6. Gastro-intestinal: The disease may simulate acute appendicitis, acute gastro-enteritis or infectious hepatitis. In a small percentage of cases of infectious mononucleosis jaundice is present.

There is no specific treatment of infectious mononucleosis. Berkeley[11] reported successful treatment with scarlet fever convalescent serum in 4 cases. Saltzman[12] reported good effects in 2 cases from treatment with bismuth salts. Reports such as this are difficult to evaluate in a disease of such protean and variable manifestations as infectious mononucleosis. Both sulfonamide compounds and penicillin are widely used, but it seems likely that these agents have their value in combating secondary bacterial infection, particularly in the upper respiratory manifestations of the disease. Recrudescence and postinfectious asthenia are very common.

Agranulocytosis usually manifests itself as an acute, severe, necrotizing pharyngitis associated with chill and fever. There is severe leukopenia with striking diminution or absence of granulocytes and monocytes. The lymphocytes constitute the main leukocytes of the circulating blood, but they do not appear to be abnormal. The

bone marrow in cases of agranulocytosis exhibits either marked hypoplasia or hyperplasia. The latter finding has been described as a "maturation arrest" phenomenon, but serial studies in cases of agranulocytosis may reveal that this is a recovery phase rather than a block between the myelogenous tissues and the peripheral blood. Many of these general considerations are illustrated in the following case.

REPORT OF A CASE

The patient was a white man, aged 19 years, who was admitted to our service on March 29, 1947. He had recently been discharged from military service after return from duty with the army of occupation in Germany. In childhood he had had measles, mumps and pertussis. He had not had upper respiratory infections common to childhood. His first severe upper respiratory infection had occurred four months before he came to the clinic. This had been called "acute tonsillitis" and had been treated in the battalion hospital by the administration of sulfonamide drugs. He had had fever, sore throat and some swelling of the cervical lymph nodes. He was sick for a period of ten days at that time before return to duty. He stated that in the following four months he had never felt quite well. He did not note any enlargement of his lymph nodes in the interim. His family history was essentially negative.

The patient was seen by the Mayo Clinic outcall physician on March 27, 1947. The physician noted a marked follicular tonsillitis with severe cervical, axillary and inguinal adenopathy. The patient had a low-grade fever. Prior to the laboratory studies the attending physician suspected either acute leukemia or Hodgkin's disease. The patient was sent to the hospital for study and treatment.

On admission to the hospital, the initial examination revealed a young white man who appeared moderately ill. His temperature on admission was 100° F. Both tonsils were moderately inflamed and enlarged, and white exudate oozed from the tonsillar crypts. The cervical nodes formed a huge tender collar. The axillary and inguinal lymph nodes were moderately enlarged and tender. The spleen was felt three fingers below the left costal margin and was only slightly tender. The patient was relatively comfortable at rest in bed but did not wish to eat or drink because of his sore throat. The results of his physical examination were otherwise essentially negative.

The immediate laboratory studies were not conclusive. The results of urinalysis were normal. A throat culture failed to reveal

either diphtheroids or hemolytic streptococci. The hemoglobin and erythrocyte count were within normal limits (hemoglobin 14.8 gm. per 100 cc. of blood, erythrocytes 4,740,000 per cmm. of blood). Leukocytes numbered 10,400 per cmm. of blood, of which 70% were neutrophils and 25.5% were lymphocytes. A morphologic study at this time was not diagnostic. On x-ray examination the thorax appeared normal.

Because of the tonsillitis, the patient was given sulfadiazine orally, but at the end of 24 hours its administration was discontinued because of the appearance of a generalized macular skin eruption. Instead, penicillin was administered in a dosage of 120,000 Oxford units per day.

At the end of the patient's second day in the hospital, the laboratory reported that the leukocyte count was 17,500 per cmm. of blood, of which 60% were lymphocytes. Many of these were of the leukocytoid type seen in cases of infectious mononucleosis. Neutrophils constituted 27% of the leukocytes. At this time the heterophil antibody titration was reported positive up to the dilution 1:896. It was our opinion that the diagnosis of infectious mononucleosis in a moderately severe form was established.

The patient's temperature continued to vary from 99° to 100° F. The tonsillitis and lymphadenopathy slowly improved. The leukocyte count continued to vary between 10,000 and 13,000 per cmm. of blood, with 70% to 80% atypical lymphocytes. There were granulocytes present in adequate numbers. Many of the neutrophils exhibited toxic granulation.

On April 7, his seventeenth day in the hospital, the patient had improved to the point where we thought that he could continue his convalescence at home with observation at the clinic as an outpatient. The tonsillitis had cleared. He still had, however, a moderately generalized adenopathy and barely palpable splenomegaly.

During the next two weeks the patient was seen frequently at the clinic. He had no fever but felt very exhausted and lacked appetite. The lymph nodes still remained moderately enlarged and tender. On April 19, blood studies revealed a total leukocyte count of 4,300 per cmm. of blood, of which 63% were atypical leukocytoid lymphocytes, 27% neutrophils, 6% monocytes, 3% eosinophils and 1% basophils. On this date he complained of a small ulcer on the buccal surface of the lower lip.

Two days later, April 21, the patient complained that since his last visit he had had some fever in the evenings. Several more small

oral ulcers had developed in the region of the lower right third molar, and his throat had become sore again. Examination at this time revealed a recurrence of the patient's follicular tonsillitis. The tonsils were enlarged and inflamed, with exudate oozing from the crypts. They did not show the necrotic regions seen in many cases of agranulocytosis. There was some re-enlargement of the cervical nodes but not to the degree seen originally. At this time the total leukocyte count was 2,300 per cmm. of blood, of which 93% were lymphocytes, 5.5% monocytes, 1% neutrophils and 0.5% basophils. Some of the lymphocytes were leukocytoid, but many of them were small mature cells. The patient was again hospitalized.

At the time of readmission to the hospital his temperature was 103° F. Shortly thereafter the patient had a chill with further elevation of his temperature to 105° F. He was quite ill and had great difficulty in swallowing but did not exhibit the marked prostration often seen in cases of agranulocytosis. A culture of the tonsillar exudate was later reported positive for hemolytic streptococci. Blood cultures were taken and later reported negative. Treatment was immediately started with penicillin in doses of 720,000 Oxford units per day.

For the next four days the patient's temperature ranged between 104° and 105° F. On the second day in the hospital he had another chill. Because of dysphagia, it was necessary to supplement oral feedings with intravenous administration of fluids. The severe inflammation and edema of the tonsils and pharynx continued but no necrotic ulceration developed. A tracheotomy set was kept ready in the event of laryngeal obstruction.

During these four days, total leukocytes varied between 1,500 and 1,900 per cmm. of blood. Careful study of stained smears failed to reveal any granulocytes during this time. Differential counts showed 96% to 99% lymphocytes and from 4% to 1% monocytes.

On the second day in the hospital sternal aspiration was performed (Fig. 1). This revealed a relatively hypocellular marrow. The red cell line was normoblastic. The number of megakaryocytes present appeared normal, but comparatively few myeloid cells were present and these were mainly at the promyelocyte stage or more immature. The few myelocytes appeared heavily granular and "toxic." The lymphocytes present were mostly of the small mature type. A few leukocytoid forms were seen.

To exclude the possibility that the region aspirated was not typical, and in hopes that we might detect some evidence of favor-

able change, another sternal aspiration was done the next day. The results were essentially the same as on the previous day.

In both of these specimens, then, we had the picture so often seen in cases of agranulocytosis hypoplasia of the myeloid line with arrest of development at a relatively primitive level.

On the fifth day in the hospital, the patient noted subjective improvement. His throat was less sore, he could swallow liquids and soft food more easily and his temperature declined 2° F. On the sixth day, the patient's temperature was within the normal range and his throat was much better subjectively and objectively. The total leukocyte count rose to 4,800 per cmm. of blood, of which 58% were lymphocytes, 12% monocytes, and 30% neutrophils. Most of the lymphocytes were normal in appearance but a few were leukocytoid. The neutrophils showed heavy "toxic" granulation, and many nonsegmented forms were present.

Another sternal aspiration was performed at this time (Fig. 2). The cellularity of this preparation appeared normal; the myeloid line was very active and appeared to be shifted somewhat to the left. The granulocytes showed heavy, "toxic" granulation.

On the sixth day, the dosage of penicillin was reduced to 160,000 units per day. The further return to normal in the throat and lymph nodes was rapid, and very soon the patient stated that he did not feel ill at all. He was dismissed from the hospital on the fourteenth day. At that time leukocytes numbered 6,700 per cmm. of blood, with 57% neutrophils, 36% lymphocytes, 6% monocytes and 1% eosinophils. A few of the lymphocytes still showed leukocytoid characters.

We continued to observe the patient throughout the following summer and autumn. During the summer he had an occasional mild sore throat but no signs of inflammation could be noted. Throughout this time his spleen was no longer palpable. His leukocyte count ranged between 4,000 and 6,000 per cmm. of blood. Differential counts showed an average granulocyte percentage of 50 with an average lymphocyte percentage of 40 to 45. Only an occasional lymphocyte showed leukocytoid characteristics.

Tonsillectomy was planned for early autumn, but before this could be accomplished another attack of acute follicular tonsillitis developed. This attack, however, appeared to be typical follicular tonsillitis with minimal enlargement of the cervical nodes. During this attack the patient exhibited mild neutrophilic leukocytosis. No

leukocytoid lymphocytes were seen at that time and the infection cleared up promptly. During this attack, large doses of penicillin (1,000,000 units per day) were given because of the previous history.

Five weeks after the recovery from the follicular tonsillitis, tonsillectomy was performed. At this time medium sized tonsils were removed without difficulty. Since that time the patient has been clinically well.

SUMMARY

In cases of infectious mononucleosis, agranulocytosis is an occasional complication. Because of the possibility of this complication, continued observation of the patient and his blood status is necessary. One can infer that when the secondary bacterial infection in cases of infectious mononucleosis is treated with various bacteriostatic agents, it is probably safer to use penicillin than sulfonamide compounds.

A case is reported illustrating infectious mononucleosis complicated by agranulocytosis with recovery. The patient had been given sulfonamide drugs four months prior to our observation, and for 24 hours early in our care of him. Administration was discontinued because of a skin eruption. Agranulocytosis occurred 30 days after this. Because of this long interval it is probable that the agranulocytosis did not develop as the result of the sulfonamide drug.

MAYO CLINIC.

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XCVII

A CASE OF TRAUMATIC TONAL DIP, ASSOCIATED WITH PARACUSIS AND DIPLACUSIS

A. Bachem, Ph.D.

Chicago, Ill.

H. K., one of the author's subjects for his studies on absolute pitch, about 15 years ago, was a musical boy of 9 years. He was found to possess genuine absolute pitch with errors of semitones and fifths. His hearing was normal except for some high tone weakness in his right ear, with the upper limit of hearing observed at about 15,000 c.p.s.

In 1948, H. K., now a sophomore medical student 24 years old, visited the author again and gave the following history: In 1932 he had had right otitis media in conjunction with pneumococcus pneumonia. No perforation of the tympanic membrane occurred. Six years later, hearing deficiency was first noticed. In 1944 an 88-mm. shell explosion, 10 feet to his left, caused perforation of the left ear drum and brain concussion with syncope, followed by delirium for a period of one week. Hearing loss and decreased acuity for absolute pitch were noticed afterward.

Audiometric tests were performed with a standard audiometer and by means of a beat frequency oscillator for a continuous frequency scale (Fig. 1).

Figure 1 shows that while low tone hearing is normal, high tone hearing is restricted to 13,300 c.p.s. in the left ear and to 10,400 c.p.s. in the right ear. The left ear exhibits a sharply limited tonal dip between 2500 and 6000 c.p.s., with a maximum hearing loss of about 60 decibels at 3400 c.p.s. The dip is so narrow that it could be overlooked by a standard audiometer test at octave intervals, if the maximum fell in the center of such an interval.

The absolute pitch was of the same type and of similar acuity as found 15 years previously, with considerable changes observed above 3000 c.p.s. and in the low frequency range.

The upper chroma limit was G. It was gradually approached in the right, relatively normal, ear. It was reached "by detour" in

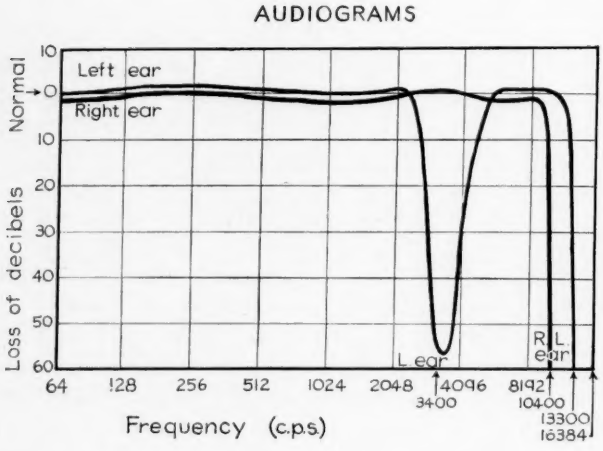
AUDIOGRAMS
Left ear
Right ear
Normal
Loss of decibels
10
0
10
20
30
40
50
60
L ear
R L ear
64
128
256
512
1024
2048
4096
8192
3400
10400
13300
16384
Frequency (c.p.s.)

Fig. 1.

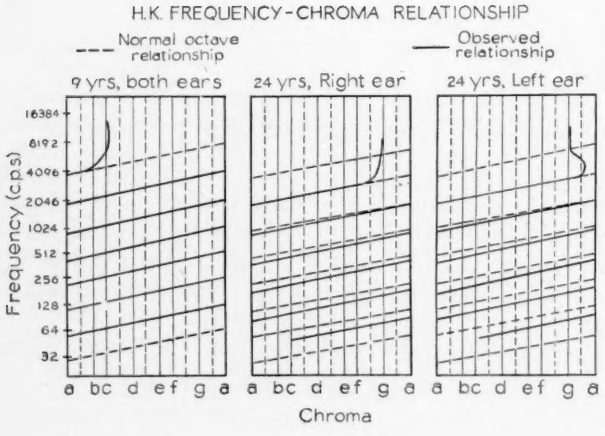
H.K. FREQUENCY-CHROMA RELATIONSHIP
Normal octave relationship
Observed relationship
9 yrs, both ears
24 yrs, Right ear
24 yrs, Left ear
Frequency (c.p.s.)
16384
8192
4096
2048
1024
512
256
128
64
32
a bc d ef g a
Chroma

Fig. 2.

the left, the more traumatized ear, by overshooting to G# and returning to G (Fig. 2).

Figure 2 reveals another abnormality of absolute pitch perception not observed before. While the absolute pitch judgments are correct in the region of 2000 c.p.s., there appears a gradually increasing error towards lower frequencies. This judgment error is toward higher pitch and reaches as much as two tones in the region of 100 c.p.s. This observation is an exception to the rule that the chroma is a function of frequency with strict octave periodicity throughout the whole musical range.

A different exception to this rule was reported by v. Liebermann and Révész,[1] and was discussed further by Révész[2] as a "paracusis qualitatis". In this case, the tone quality (chroma[3]) remained the same (G#) over several octaves (once from A_2 to $G\#_3$, at another time from G_2 to $C\#_4$), while the tone height increased normally with increasing frequency. Révész discussed this case as an interesting abnormality of pitch perception in favor of his distinction between tone height and quality (chroma) as two aspects of pitch. An explanation of the underlying pathology was not attempted.

The author's observation of a gradually increasing "paracusis qualitatis" may be considered as an abnormal variation of chroma fixation,[4] which occurs normally over a limited area at the end of the musical scale.

A differential study by comparing closely the hearing of both ears revealed a diplacusis of such a small degree that it could have escaped clinical methods of observation. All tones of frequencies below 2900 c.p.s. appeared lower to the traumatized left ear. The difference was estimated at 1/3 to 1/2 semitone. Above 3000 c.p.s., tones appeared higher to the left ear. The maximal difference was 1/2 to 2/3 semitone and occurred right above the center of the tonal dip. From 5000 c.p.s. onward, no differences were observed. The subject noticed beats in the low tone region and was able to count them. They ranged between two and eight per second, corresponding to the order of magnitude of the diplacusis. The author is unable to account for the occurrence of beats, however, since the stimulating frequencies, as well as the frequencies of the vibrating normal and abnormal basilar fibers, were identical. A central explanation for the perception of beats is not available either. Binaural beats were observed recently by Minton[5] in a case of diplacusis,

but he made no attempt to explain this. The subject also noticed rapid variations of sound localization, resulting in vertigo. Baranyi chair tests indicated increased vestibular sensitivity within normal physiological limits.

It seems significant that the largest increase of pitch occurred near the maximum of the tonal dip, decreasing towards both borders of the dip. This fact can be explained by the assumption that the injury which led to the impaired hearing in the 3400 c.p.s. region forced the basilar fibers out of tune. Either it caused a tissue proliferation which increased the inertia of the resonating structures, or it lowered the tension of the fibers in that region. These fibers, therefore, respond to stimuli of lower frequency than the normal fibers, but they evoke the normal pitch sensation, inherent in the corresponding sensory area. Thus, high pitch paracusis results.

The low pitch diplacusis, mentioned before, presents itself as a paracusis, slightly different in both ears. It may be due to a traumatic change, similar to the one associated with the tonal dip, but increasing towards the apical end of the cochlea, due to the impact of endolymph at the blind end of the scala media. The low tone paracusis is smaller in the left, more traumatized, ear than in the right one. It may be assumed that the basilar disturbance that caused the tonal dip in the left ear eased the endolymph pressure somewhat in the apical region of that ear.

SUMMARY

A case of a sharp tonal dip, associated with paracusis and diplacusis, is described. The pathology was caused by a shell explosion, since hearing and absolute pitch were rather normal before, but greatly altered after the injury. The tonal dip is caused by a very limited destruction of the basilar membrane or the organ of Corti. The paracusis is due to alteration of the physical condition of the basilar membrane, forcing it out of tune, particularly at the center of the tonal dip and toward the apex of the cochlea. The diplacusis results from the differences between the paracusis of both ears.

UNIVERSITY OF ILLINOIS.

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XCVIII

A MODIFIED TRACHEOSTOMY TUBE

R. B. White, M.D.
AND
G. A. Olander, M.D.

Hines, Ill.

Patients with cancer of the larynx who have undergone total laryngectomy frequently develop the annoying complication of fistula. The fistula usually occurs between the hypopharynx and the wound. The result is that saliva, and occasionally serum from the wound, continually pour down into the trachea around the silver tracheostomy tube. The patient has to be fed through an indwelling stomach tube. He loses sleep, loses weight, often becomes mentally depressed, and may, by violent coughing, cause a hemorrhage. If he should vomit there is danger that he might aspirate some of the vomitus into the tracheostomy.

The present writers have had the opportunity of caring for a relatively large number of laryngectomized patients. Those who developed fistulae within a week after surgery were those whose carcinoma extended into the anterior wall of the hypopharynx or upper esophagus. In such cases the anterior wall was removed and the remainder closed over an indwelling feeding tube.

At this hospital a modification of the standard silver tracheostomy tube is being used on these patients. An inflatable cuff used by the anesthetists on their endotracheal tubes is fitted over the tracheostomy tube. This is inserted into the tracheal stoma, and the cuff is then inflated to provide a snug fit. This works as a dam which diverts the flow of saliva to the skin where it may be absorbed on the dressings.

The modified tracheostomy tube has been used to advantage in 25 patients thus far. It has added considerably to their comfort by almost eliminating the need for endotracheal aspiration of secretions

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From the Tumor Service, Veterans' Administration Hospital.

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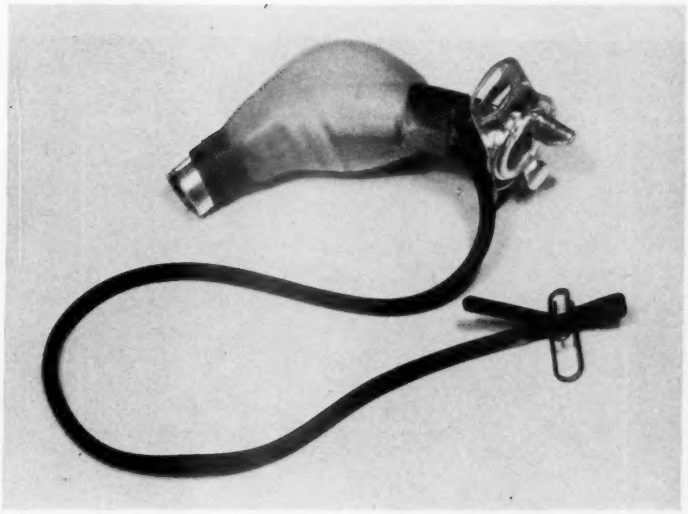


Fig. 1.—Tracheostomy tube with cuff inflated.

with the suction apparatus. These patients can sleep undisturbed throughout the night, they cough less frequently, and they can learn to use their artificial larynx for speaking without having to stop to clean away the saliva every few minutes.

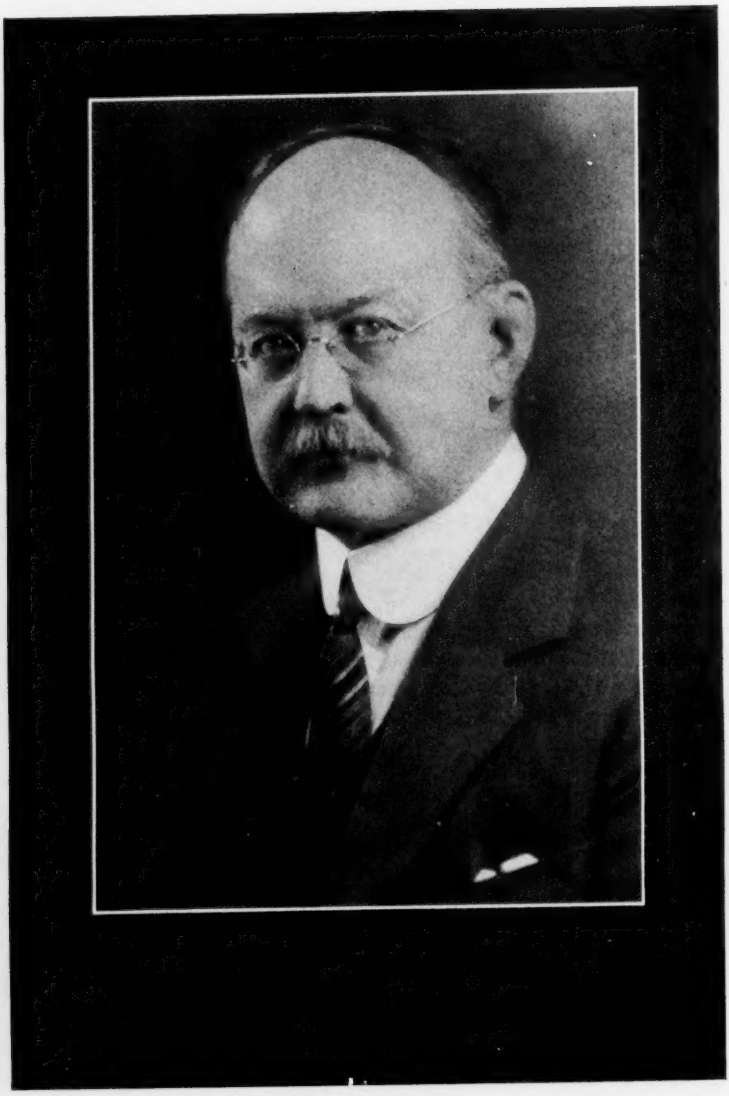
The possibility of pressure necrosis of the tracheal lining occurred to us, but this has not been found after three months of continuous use of the cuff in several patients. The tube and cuff can be sterilized together in the usual manner, but the daily use of soap and water followed by soaking ten minutes in 70% alcohol has been found to give longer life to the cuff.

SUMMARY

A modification of the standard tracheostomy tube by the addition of an inflatable rubber cuff is presented.

Its use is indicated in tracheal stomas that are subject to excessive secretions, particularly in patients who develop fistulae following panlaryngectomy.

VETERANS' ADMINISTRATION HOSPITAL.



J. GORDON WILSON, M.D.

1858-1948

J. Gordon Wilson was born in Edinburgh, Scotland, on December 10, 1858. He was educated in the local preparatory schools and graduated in medicine from Edinburgh University in 1890. The next two years were spent in Europe at the Universities of Vienna, Berlin and Strasbourg. At the latter place he spent much time with Dr. Bethe who was a pioneer investigator in intravitam staining. This study formed the foundations for Dr. Wilson's later investigation in this subject.

On returning to Scotland he practiced general medicine in Glasgow where he was a staff member at the Victoria Hospital.

In 1900 he accepted a fellowship in Anatomy at the young University of Chicago and came to America to do research on the ear and teach anatomy of the head and neck. During this period he published his work on intravitam staining of "The Nerves of the Membrana Tympani in Man" and "The Nerves of the Atrio-Ventricular Bundle of His".

In 1908 he went to Northwestern University and was made Professor of Otology. Later he became professor and chairman of the Department of Otolaryngology, a position he held until his retirement in 1939.

Dr. Wilson was always an investigator and shortly after moving to Northwestern he became interested in the labyrinth. This involved the use of experimental animals, and he spent many long hours in the laboratory making observations on the mechanism of labyrinthine nystagmus and its relation to lesions in the cerebellum and cerebrum. Several papers were published on nystagmus at this time.

In 1915 Dr. Wilson offered his services to the Canadian Expeditionary Forces and was sent to France as a Captain. He saw first line duty and suffered some auditory injury from exposure to high explosives. He published three papers shortly thereafter on the "Effects of High Explosives on the Ear".

Returning to Chicago after the war he immediately began his investigative work on the petrous temporal bone and the utriculo-endolymphatic valve. Several papers were published on these subjects in cooperation with Dr. Barry Anson.

Keenly interested in otosclerosis, he was one of the few American representatives at the International Oto-Laryngologic Conference in Madrid in 1932, where he presented a paper on "Recent Investigation on Oto-Sclerosis".

In 1928 he was elected president of The Institute of Medicine of Chicago. His presidential address was entitled "The Influence of Edinburgh on American Medicine of the Eighteenth Century". This historical paper dealt chiefly with Dr. Benjamin Rush and his contemporaries.

Dr. Wilson spent the past ten years in semiretirement at his home in Old Bennington, Vermont. However, his zeal for investigative work would not allow him to be idle and each winter he returned to Chicago where he continued to examine new material for his studies on the petrous temporal bone. He died in Old Bennington, Vermont, on August 13, 1948.

JOHN F. DELPH.

Society Proceedings

SIXTY-NINTH ANNUAL MEETING

OF THE

AMERICAN LARYNGOLOGICAL ASSOCIATION

Hot Springs, Va., April 14-15, 1948

DR. ARTHUR W. PROETZ, PRESIDENT, PRESIDING

(Abstracts of Proceedings)

Tonsillectomy in the United States

LAWRENCE R. BOIES, M.D.

MINNEAPOLIS, MINN.

(This paper appeared in full on page 352 of the June 1948 issue.)

DISCUSSION

DR. BURT R. SHURLY agreed that the relationship of tonsillectomy to poliomyelitis was very much overdrawn. He had never seen such a case in his experience with more than 20,000 tonsillectomies. Publicity has done much to instill a fear of the operation in the minds of the laity, as a result of which many individuals who would be greatly benefited by the operation are denied its benefits.

DR. JOHN D, KERNAN considered the problem an exceedingly important one in view of the fact that around two million tonsillectomies are done in the United States every year. Many questions in this connection are still unanswered, particularly those dealing with the function of the tonsils and the effect of their removal on the general economy. The appearance of lymphoid nodules throughout the pharynx after the operation leads one to speculate on the biochemistry involved and the possibility of a physiologic demand for this tissue. He believes that there are many good reasons for doing the operation, but would like to have them supported by more scientific data than have as yet been available.

Dr. Henry M. Goodyear added mouth breathing, attacks of otitis media, and enlarged cervical glands to the list of indications given by Dr. Boies. Also, he feels that the adenoid operation should be considered at the same time since the two are usually done in one sitting. The operation is not a simple one, and general practitioners should be discouraged from doing it. Also, he is opposed to the procedure being done with the head in the extended position because it interferes with proper visualization of the adenoid region. It is important that a satisfactory palate retractor be employed so that the adenoids may be removed under direct inspection. As for recurrence of lymphoid tissue, he is convinced that the administration of iodine for a period of time, occasionally with thyroid extract, will do much to retard this unpleasant phenomenon.

Dr. Milton Robb found, on dissecting a number of rats, that there was no lymphoid tissue in the pharynx. Since this animal lives under most unhygienic surroundings and eats dirty food, it is difficult to understand the absence of this tissue if it had any value in protecting the organism against infection.

Dr. Kernan stated that the pig lives under most unhygienic conditions, certainly as bad as the rat, and so far as he knows the animal possesses tonsil tissue.

Dr. Boies (in closing) stated that it was his understanding that the rat, as well as all mammals, has tonsils.

Lermoyez's Syndrome—An Allergic Disease

Watt W. Eagle, M.D.

Durham, N. C.

(This paper appeared in full on page 453 of the June 1948 issue.)

DISCUSSION

Dr. Francis L. Weille stated that at a recent staff meeting of the Massachusetts Eye, Ear and Throat Hospital, the chief of the allergy service made the statement that he had never seen a case of vertigo in which allergy had played an important role.

Dr. Marvin P. Jones referred to a paper he had published in the Annals of Otology, Rhinology and Laryngology some years ago entitled "Allergy of the Ear," citing eight cases in which the connection was definitely proven.

DR. WILLIAMS recalled the fact that Ménière's original paper reported a series of cases in which deafness was the earliest symptom, often appearing years before the onset of vertigo. Concerning the role of histamine in Ménière's syndrome, the work of Farmer in New York and others has thoroughly discredited its importance. Neither did he believe that the histamine skin test was of any value so far as diagnosis is concerned.

In Dr. Williams' clinic an average of 250 cases a year are diagnosed as Ménière's or Ménière syndrome, among which he has noted only one that might possibly be considered as a Lermoyez syndrome. This case was in a woman past the menopause, whose audiogram was typical of otosclerosis. Her attacks of vertigo, nystagmus and vomiting were relieved by stilbesterol.

Attention might be called to the fact that asthma, angio-edema and such conditions are often not the result of an antigen-antibody reaction, but rather a manifestation of physical allergy. The work of Gottfried, Mueller and others leaves one in doubt as to whether these manifestations are truly the result of an allergy. It all depends on the definition the particular author wishes to employ.

DR. EAGLE (in closing) admitted being confused by the history of Ménière's disease, especially in view of the recent interpretations of contemporary investigators. He felt that his presentation of the Lermoyez syndrome might help to separate the doubtful from the true Ménière's. He still was of the opinion that it is an allergic disease and he still would consider urticaria as an allergic phenomenon.

The Cross-Sectional Area of the Lower Respiratory Tract at Different Levels and its Possible Physiological Significance

A. C. HILDING, M.D.

DULUTH, MINN.

(This paper appeared in full on page 324 of the June 1948 issue.)

DISCUSSION

DR. H. I. LILLIE raised the question as to how the air is conditioned in a patient breathing through a tracheal opening.

DR. THOMAS C. GALLOWAY posed the problem of secretion accumulation in the small bronchioles and alveoli in the presence of

a respiratory paralysis. Aside from suction and postural drainage, what other mechanism would be available in ridding the passages of this material?

Dr. Hilding (in closing) said in reply to Dr. Lillie that the trachea and primary bronchi are not protected, which accounts for the early accumulation of secretion and crusting. However, these are not the essential structures requiring protection. It is the alveoli that need efficient conditioning, because it is here that the vital function of oxygenation takes place. What helps so much is the residual air already conditioned, which acts as a cushion against the smaller amount of freshly inhaled air. The latter never gets into direct contact with the alveolar wall, but reaches it only by diffusion through the already warmed and moistened residual air.

Replying to Dr. Galloway, Dr. Hilding stated that in respiratory paralysis the cilia themselves are not affected. They act independently of any nervous mechanism. They do function effectively in carrying the secretions up to the major bronchi. The failure to expel the accumulation is a mechanical impediment due to the paralysis.

Nerve Distribution of Clinical Significance in Laryngology

A. C. Furstenberg, M.D.

Ann Arbor, Mich.

(This paper appeared in full on page 298 of the June 1948 issue.)

DISCUSSION

Dr. Norton Canfield cited two cases in which he hoped a solution to the dilemma might be forthcoming on the basis of Dr. Furstenberg's studies. They had to do with two infants in whom tracheotomy had to be performed to relieve distress due to respiratory croup with laryngeal infection. Subsequent attempted removal of the tubes was always followed by spasm, which necessitated replacement a number of times. In one case it was six months before the child could do without the tube.

Dr. Marvin F. Jones was impressed with Dr. Furstenberg's discussion of the nasal obstruction following the septum operation, because it brought to mind his own observation of the same complaint in patients with atrophic rhinitis. He is convinced that the

break in the reflex arc is due to a degenerative process following either trauma or disease. Disturbance of the reflex arc is only one of the manifestations of the degenerated end-organ; one will also find sensation blunted and secretions abnormal. In other words, the membranes are nonfunctioning.

Dr. Chevalier L. Jackson mentioned another instance in which disturbance of a reflex arc was responsible for difficulty in respiration, namely, a laryngectomized patient who complained of difficulty in getting his breath despite an adequate stoma and negative physical findings. Dr. Jackson wondered whether the difficulty was to be explained on a psychosomatic basis or was truly an interference with the normal reflex arc.

Dr. Harold I. Lillie inquired how one could explain the arrest of sneezing bouts by pressure on the upper lip. In connection with the nasal respiratory arc he had observed atrophy, loss of sensation and impaired nasal breathing following zinc ionization.

Dr. James M. Robb commented on the association of tearing and sneezing. The reflex arc for tearing comes by way of the parasympathetic which arises from the nervous intermedius and passes over the gasserian ganglion, and then over the second division of the fifth and the zygomaticotemporal branch to the lacrimal gland. He asked whether Dr. Furstenberg could connect up the fifth nerve with the reflex arc to explain the association of tearing with sneezing.

Dr. Louis H. Clerf inquired about the reflex arc which would account for sneezing attacks when coming out of a dark room into the sunlight.

Dr. Arthur Proetz added an observation of a patient in whom sneezing could be induced by touching the hairline on the side of the head.

Dr. Furstenberg (in closing) believed that Dr. Canfield's and Dr. Jackson's cases could be explained on the basis of irritation of the tracheal mucous membrane; the reflex arc by way of the recurrent laryngeal nerve through fibers from the vagus to the medulla and then down the cord and to the so-called nucleus ambiguus which furnishes the motor impulses. Stimulation of the mucosa could certainly result in laryngeal spasm. Dr. Jones' observations confirmed his own with regard to nasal obstruction following operation. However, the persistence of the complaint is dependent on the degree of atrophy which, of course, would vary between the extremes of a simple submucous and a well-advanced atrophic rhinitis. Concerning Dr. Lillie's inquiry, he believed that sneezing may be

stopped by pressure on the upper lip because the pressure causes sufficient pain to stimulate the inspiratory center and halt the attack. Replying to Dr. Robb and Dr. Lillie, Dr. Furstenberg showed a slide in which the connections between the fifth and seventh nerves were shown. Furthermore, it showed how fibers of the seventh pass around the nucleus of the sixth nerve. It is possible that a synapse exists in this area.

The Etiology, Treatment and Prevention of Chronic Sinus Infection

SAMUEL J. CROWE, M.D.

BALTIMORE, MD.

(This paper appeared in full on page 364 of the June 1948 issue.)

Associated Symptomatology of Diseases of the Epipharynx

WALTER H. THEOBALD, M.D.

(This paper appeared in full on page 677 of the September 1948 issue.)

DISCUSSION

DR. F. T. HILL emphasized the value of direct inspection. He has found electrocoagulation useful in attacking lesions in this vicinity, using the Yankauer speculum as the indifferent electrode. In acute epipharyngeal infections it is well to bear in mind the possibility of diphtheria, particularly in patients whose tonsils have been removed.

DR. THOMAS C. GALLOWAY recalled the experience of his former colleague, Dr. Profant, who had cured a man with a disabling arthritis by removing a pharyngeal bursa which had escaped the attention of 15 otolaryngologists who had previously treated the man. Dr. Galloway is very much interested in the question of the importance of lymphoid nodules, being of the impression that they do act as a nidus of infection, often a very important one. He has had some success in eliminating these foci by using a punch forceps under direct inspection via a Love retractor. If islands of epithelium are left between the denuded areas, the raw spaces will soon be covered over and extensive scarring prevented. When a bursa is encountered it can be cured only by surgery. Irradiation may be

used with caution. There are cases where the lymphoid tissue reacts by increased growth rather than regression.

Dr. Samuel Salinger finds direct examination with the pharyngoscope or palate retractor very difficult in many children. He has had success in visualizing the region by anterior rhinoscopy after thorough shrinking of the turbinates. Having been trained to use the Kirstein headlight, he finds no difficulty in focusing the light on the nasopharynx through the dilated nasal passages.

Dr. Theobald (in closing) expressed his satisfaction in clearing up obscure cases of fever and bleeding which had baffled the internists in these cases, by tracing them to a chronic lesion in the epipharynx. Direct examination is the only way in which the entire field can be minutely examined and the furrows, crypts and hyperplasias located and evaluated.

Complications Following Irradiation of the Thyroid Gland

N. M. Lukens, M.D.

Philadelphia, Pa.

(This paper appeared in full on page 633 of the September 1948 issue.)

DISCUSSION

Dr. Louis H. Clerf recalled having reported similar experiences 20 years ago. He has since then seen additional cases of this type where the damage to the overlying soft tissues of the neck resulted in telangiectasis, induration, atrophy, etc. In one case the patient, who had received irradiation 12 years ago for a benign lesion, developed a post-cricoid carcinoma. It is therefore possible to encounter a malignancy due to the degenerative changes caused by injudicious irradiation.

Radiation therapy for benign lesions should be administered only by the most experienced radiologists who realize its limitations as well as its possible threat to normal tissues.

Dr. Arthur Jones reported a fatal case of ascending myelitis of the cord following extensive irradiation for carcinoma of the larynx in a girl of 13. A pathologist who discussed this case when it was reported stated that he had seen ten cases of ascending myelitis following deep x-ray therapy in the cervical region.

Dr. Samuel Salinger, reporting his experience with irradiation for carcinoma of the larynx several years ago, called attention to cases of necrosis and sloughing. More recently, he reported a case when radium applied to a child's neck for the cure of papillomata of the larynx resulted in marked atrophy of the soft tissues and definite arrest in the development of the larynx. Since these cases were seen some years ago, he was under the impression that they were due to improper application of the therapy. He was therefore surprised to find that bad results are still being seen at a time when we are led to believe that irradiation therapy is safe. It is apparent that all patients receiving radiation therapy to the neck should be followed closely, not only by the roentgenologist but by the laryngologist, for several years. Certainly consultation with the laryngologist in the first place should be a desideratum.

Dr. Thomas C. Galloway inquired whether Dr. Lukens had any information as to the value of irradiation in carcinoma of the thyroid gland.

Dr. Lukens (in closing) stated he had had no experience with x-ray therapy for carcinoma of the thyroid, but had been told by roentgenologists that it was indicated. As a matter of fact, he had seen several so-called "cured" cases still showing evidence of progression.

Mucoceles, Pyoceles and Cystic Degenerative Lesions of the Mucous Membrane of the Frontal and Ethmoidal Paranasal Sinuses

Harold I. Lillie, M.D.
and
C. F. Lake, M.D.

Rochester, Minn.

Analysis of 44 cases of mucocele, pyocele and cystic degeneration in the frontals and ethmoids reveals a history of previous infection or trauma, often with subsequent episodes of pain and nasal congestion occasionally relieved by spontaneous discharge due to rupture and intranasal drainage. Resorption of bone due to pressure of the growing mass leads to orbital invasion with diplopia, or to exposure of the dura. X-rays are helpful in diagnosis, although if the lesion is deep-seated it may at times be difficult to differentiate it from a primary orbital tumor. Also, when the mass completely

fills the sinus it will be difficult to determine its origin. The therapy is surgical, but the approach will depend on whether the cyst is seen before there are any external evidences of it; also on the status of the duct. The latter is not to be disturbed if it is sufficiently patent. The mass should be removed completely in most cases through an external approach.

Lantern slides were presented showing various types of histology, x-ray pictures and reconstructed cysts after removal.

DISCUSSION

DR. HENRY M. GOODYEAR is not in favor of removing the lining of the cyst in any case in which it can be adequately and widely opened through an intranasal operation. The lining in itself constitutes no danger. Recurrence can follow only if it becomes closed off again. Complete resection through an external operation involves the possibility of stenosis of the nasofrontal duct from fibrosis. Dr. Lillie's series of 44 cases included 22 which had previously been operated on. These are naturally very difficult and do require radical surgery.

DR. W. L. SIMPSON has had his best results in these cases following extensive resection through an external operation. He removes all the ethmoid cells, cleans out the sphenoid and widens the duct while leaving the middle turbinate in situ.

DR. LILLIE (in closing) stated that he does not see the necessity for removing all the lining of the frontal sinus in the majority of cases, nor does he find it necessary to remove all the ethmoid cells. Naturally, suppurative cases fall into a different category. The point is that the surgical procedure must be adapted to the individual case, and cannot in all cases be identical.

Aliphatic Versus Aromatic Amines as Vasoconstrictors

K. K. CHEN, M.D.

INDIANAPOLIS, IND.

(This paper appeared in full on page 287 of the June 1948 issue.)

DISCUSSION

DR. ERNEST M. SEYDELL asked about the habit forming effects of ephedrine by mouth in comparison with its local use.

DR. MARVIN F. JONES inquired about dosage in the same connection.

DR. JOHN J. SHEA was interested in the effect on the blood of long-continued administration of antihistamine drugs.

DR. BERNARD J. MCMAHON inquired about the effect of barbiturates given in conjunction with the oral administration of ephedrine.

DR. CHEN (in closing) stated that the habit formation of ephedrine was entirely psychological because true addiction involves three things, namely, physical dependence, in which the patient suffers on the withdrawal of the drug, tolerance development, in which the dosage must be increased, and psychic habituation. Morphine is a good example. Ephedrine habituation is a psychic habit pattern due to the inferiority of the individual. No data has ever been presented to substantiate any theory that ephedrine is habit forming and that applies even to the psychic aspect. There should be no difference between local and oral administration so far as habit formation is concerned. As far as dosage is concerned, Dr. Chen, in his early experiments, was guided by the results of animal experiments and had himself taken as high as 150 mg. which is a huge dose compared to present usage. About 25 mg. three times daily is now considered adequate. Patients who react by becoming jittery should be instructed to lower the amount.

Concerning the antihistamine drugs, he had seen no demonstrable effects on the blood in all the experiments at his laboratory.

The combination of a barbiturate with ephedrine should act well when given at night, since it would protect the patient against insomnia, particularly if the individual were sensitive.

In response to a query from Dr. Thomas Galloway, Dr. Chen stated that the oral administration of ephedrine may be followed by a late turgescence such as is seen some time after its local use.

Responding to another question from Dr. O. E. Van Alyea concerning the effect of privine, Dr. Chen stated that this drug is constructed entirely different from the aromatic amines or the aliphatic amines, which was why he did not mention it in the paper. As to the question "is there any justification in the requirement of the Government that the label on nose drops of the vasoconstrictor types give warning of possible danger to individuals suffering from heart disease, thyroid disorders, diabetes and hypertension", Dr. Chen said that as long as the manufacturer does not prove conclusively that the

agent cannot possibly kill or injure, the notice on the label is required. The law is not perfect. It would perhaps be better if the product were put in the hands of the physician for a sufficient length of time to judge its possible side effects before granting clearance for public sale.

Laryngeal Tuberculosis

E. A. Looper, M.D.

Baltimore, Md.

(This paper appeared in full on page 754 of the September 1948 issue.)

DISCUSSION

Dr. Burt K. Shurly expressed his pleasure in witnessing the improving results of therapy over a period of many years. The incidence, in his experience, has gone down from 15 to 8 per cent. One hundred cases are now being treated with streptomycin in his institution, and the results of one gram daily doses have been encouraging. The drug is withdrawn at the first sign of labyrinthine disturbance.

Dr. Louis H. Clerf emphasized the importance of routine larynx examination in all cases of tuberculosis, even when the symptoms are receding. On the other hand, laryngologists need to be on the lookout for tuberculosis in cases of suspected carcinoma. Such cases should be referred for a thorough examination of the chest since frequently the pulmonary condition is quiescent. Also, there is need for revision of textbooks which still harp on the predilection of tuberculosis for the posterior half of the larynx, since Dr. Looper has shown that any part of the larynx may be affected.

Dr. Frederick A. Figi showed three cases of laryngeal tuberculosis, in which excellent results were obtained from one gram of streptomycin intramuscularly daily and the inhalation of from 0.5 to 1 gram, combined in one case with penicillin.

Dr. Harold L. Hickey has also noted a marked decrease in the incidence of laryngeal tuberculosis in his locality. He agreed that elimination of foci of infection in the mouth and upper air passages was essential, but called attention to the danger of surgery in cases where the pulmonary tuberculosis was not arrested. He has seen the development of laryngeal tuberculosis follow closely on tonsillectomy in just such an instance.

Concerning vocal rest, it is imperative at the same time that general body rest be enforced. Even flexing of the pectoral muscles has been shown to affect the glottis.

Dr. Frederick T. Hill called attention to the importance of eliminating nontuberculous lesions in tubercular patients. A case in point was a young man with active tuberculosis, who complained of fullness in the throat, soreness and some dysphagia. Examination revealed a marked lingual thyroid, the removal of which was followed by relief of the local symptoms.

Dr. Daniel S. Cunning commented on the rarity of primary tuberculosis of the larynx, having recently seen such a case in which x-rays, serology, etc., all failed to reveal any pulmonary involvement.

Dr. Looper (in closing) stated that he had never encountered a case of primary tuberculosis of the larynx.

Moniliasis of the Larynx

C. C. Cody, M.D.

Houston, Texas

(This paper appeared in full on page 371 of the June 1948 issue.)

DISCUSSION

Dr. John J. Shea reported two cases, one of which succumbed. He agreed with Dr. Cody that x-ray pictures of the chest frequently reveal the bilateral bronchial invasion by the fungus, as was seen in his own cases, in one of which the pharynx was also involved. Iodides, thymol, cod liver oil and sodium benzoate were given for more than a month before streptomycin was tried. He emphasized the importance of the chest pictures, because it takes two to three weeks to obtain a diagnosis by culture.

Dr. Thomas C. Galloway asked whether the monilia are primarily pathogenic or saprophytic, and whether their activity depends on some systemic condition.

Dr. Cody (in closing) stated that the literature would indicate that many of the monilia do not seem to be pathogenic. Monilia albicans in connection with some pyogenic type of infection becomes of itself an invading organism. However, the situation with

regard to monilia in the larynx is similar to that of otomycosis, since mycologists are still at odds over the question as to whether a pure infection with a fungus is pathogenic. This is due to the fact that in both cases a pure infection is the exception rather than the rule.

Rhinoscleroma Apparently Cured with Streptomycin

GORDON B. NEW, M.D.

ROCHESTER, MINN.

(This paper appeared in full on page 412 of the June 1948 issue.)

DISCUSSION

DR. DANIEL S. CUNNING recalled his report to this Association last year of two cases of rhinoscleroma in native born brothers. One has died in the meantime. Since hearing of the efficacy of streptomycin, he has employed it in the other case for nine months at the rate of 1.5 gm. per 24 hours. However, aside from clearing up the secondary infection, the drug seemed to have had little influence on the lesions, which looked the same as they did before streptomycin was started.

DR. WILLIAMS reported on the use of streptomycin by inhalation as practiced by his associate, Dr. K. M. Symonton, in cases of ozena. Culture showed Klebsiella associated with pseudomonas. Although initial improvement was noted, the cases relapsed because the organisms had developed a marked resistance to the drug. Dr. Williams wondered whether the good results obtained by Dr. New, as contrasted with the poor results in the ozena cases, were not due to the larger dosage given parenterally, as against the smaller dose administered by nebulization.

DR. HENRY M. GOODYEAR inquired of Dr. Williams whether he had tried streptomycin hypodermically in any of his ozena cases. Dr. Williams replied that he had not.

DR. NEW (in closing) commented on the failure of the drug in Dr. Cunning's case, which was probably due to the fact that the germ was not streptomycin sensitive in this instance. It is very important that sensitivity tests be conducted from cultures taken from the patient before it is decided to use the drug.

Dr. New was acquainted with the work by Dr. Williams and Dr. Symonton in ozena. However, in his own case, knowing that

he was dealing with a Klebsiella that was sensitive, they hit it hard and consistently, which may have accounted for the favorable outcome.

Cancer of the Larynx

LEROY A. SCHALL, M.D.

BOSTON, MASS.

(This paper appeared in full on page 377 of the June 1948 issue.)

DISCUSSION

DR. LOUIS H. CLERF was impressed by the large number of cases that had received irradiation. It has been his experience that the results from this form of therapy seem to be getting progressively worse. Since the radiologist claims his best results in the very group where experience has proved that laryngofissure is imminently successful, Dr. Clerf feels that the results have not supported the contention. As to the decision between thyrotomy and laryngectomy, one cannot be too careful. Unless the indication for thyrotomy is clearcut, one had better advise laryngectomy because it offers more to the patient than other plans of therapy. While some larynges may be sacrificed, more patients will be saved. In this connection, it is well to remember that one must be radical. Conserving some of the structures attached to the larynx which may harbor cancer cells is a mistake. It has been his practice in some cases to do a block dissection at the same sitting, and the results have justified this procedure.

DR. JOHN D. KERNAN recalled his early experiences with laryngectomy as developed by Dr. McKenty, and is gratified with the progress achieved in the technic during the past 35 years. Yet, despite the good results being obtained, one cannot forget that without his larynx the patient is in some respects a cripple. This naturally accounts for the hedging that takes place when borderline cases come under observation. The histologic picture seems very important and can account for such bizarre occurrences as the complete recovery in one case of a carcinoma sprouting around a tracheotomy tube where the whole thyroid gland and practically all the tissues in the neck were removed. On the other hand, in a similar case similarly treated, the patient was dead within a month.

DR. CHEVALIER L. JACKSON agreed with Dr. Schall's indications for thyrotomy. If these are strictly adhered to, the five year cures will easily reach 85 to 90 per cent. As to irradiation, he was not entirely clear about the indications. Commenting on Dr. Kernan's observations, he, too, had seen cases in which it was difficult to delineate the exact boundaries of a lesion. When this is encountered during a laryngofissure operation, one had better not carry it through. There are cases in which the extension is submucous and cannot be detected with the naked eye.

As for grading, his experience coincided with that of Dr. Schall; namely, that Grades I and II give the best results from surgery and from irradiation, whereas Grades III and IV are less favorable.

DR. MCCART, acting as consulting laryngologist to the Radium Clinic in Toronto, has come to the conclusion that the early good results are not always lasting when the cases are observed over a period of years, and fall short of those obtained by surgery. Another important point is that if a case favorable for thyrotomy is treated by irradiation unsuccessfully, the patient must then have a laryngectomy. Thus a minor procedure is converted into a much more serious major operation. Furthermore, the results in these cases are not nearly as good as those in which no radiation therapy had been given.

DR. EDWIN N. BROYLES commented on the cases in which preliminary tracheotomy was necessary, it being his impression that in such cases the carcinoma had already extended beyond the intrinsic field.

DR. J. M. ROBINSON recalled an article by Dr. Rolls of the Rockefeller Institute, dealing with the virus theory in connection with carcinoma. He was impressed with the statement that tissues must be conditioned for cancer to occur. This may occur as a result of irritation from smoking, drinking, infection or alterations in body serology and chemistry. If the tissue needs to be conditioned for the development of cancer, when the cells migrate into tissue that is not conditioned they seem to have a proclivity for conditioning these new areas. The reaction to therapy differs in these two instances. Often the new area will clear up under irradiation, whereas the original nidus will resist this therapy and can only be cured by radical excision.

DR. SCHALL (in closing) stated that in his clinic the radiologists are in complete harmony with the surgeons and defer to the latter on all controversial issues. Concerning grading, Dr. Schall

has little confidence in its value as to indicating the type of therapy and can only say that the best results in all cases are obtained in cases of Grade I and II. As for indications for advising irradiation, Dr. Schall would recommend it in patients whose voice is absolutely essential to their vocation and where the growth is limited. Also, the patient must consent to be under constant observation for an indefinite period following the treatment. Too many tragedies have occurred in patients who wandered away from the clinic where they were treated.

Carcinoma of the Trachea

C. W. ENGLER, M.D.

CLEVELAND, OHIO

(This paper appeared in full on page 429 of the June 1948 issue.)

DISCUSSION

DR. EDWIN N. BROYLES recalled having reported two cases of carcinoma of the trachea. One case was kept going for 11 years by repeated fulguration. Another case seemed hopeless and was given x-ray therapy which had little effect. Autopsy showed that the lesion, though extensive, was quite superficial and might have yielded to the therapy that was used in the first case. This emphasizes the importance of good x-ray studies to determine the depth of the invasion.

Report of Postoperative Course of Subperichondral Total Laryngectomies

E. N. BROYLES, M.D.
AND
E. M. WALZL, M.D.

BALTIMORE, MD.

(This paper appeared in full on page 686 of the September 1948 issue.)

DISCUSSION

DR. LOUIS H. CLERF felt that the indications for this procedure must be well circumscribed because of the hazards of leaving

the ribbon muscles and perichondrium in which undetected nests of cells might be hidden.

DR. LEROY A. SCHALL pointed out that the mucous membrane of the epiglottis was first advocated by Dr. Harry Barnes about 15 years ago and had been employed by himself in six cases. However, all six cases developed a recurrence. Consequently, Dr. Schall has given up this procedure.

DR. JAMES M. ROBB asked the essayists to comment on the matter of recurrences.

DR. E. M. WALZL stated that the recurrences noted have occurred in the region of the cricothyroid membrane and really constituted cases that were originally unsuited for the operation. They were usually late recurrences up to five years, probably between 65 and 70 per cent.

DR. JACK MCNAUGHTON suggested that the operation might well be indicated in the borderline case where thyrotomy would be doubtful and yet laryngectomy too radical. He employed this procedure in ten cases and found that since the weak point in the closure is where the pretracheal muscles fail to lap over, just above the stump of the trachea, the wound would heal better if the skin incision veered away from the midline at this junction, thus affording a good skin flap. He asked Dr. Walzl as to the suture material used in the tracheal mucosa.

DR. WALZL (in closing) said he used triple 0 catgut. He agreed with Dr. Clerf that the indications for the operation were restricted and certainly would not advise it if there were the least suggestion of extension into the pre-epiglottic space.

Society Proceedings

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

Meeting of Monday, February 2, 1948

THE PRESIDENT, DR. JOHN R. LINDSAY, IN THE CHAIR

The Scientific program was presented by the University of Illinois representatives to the Veterans' Hospital, Hines, Ill.

Introduction

FRANCIS L. LEDERER, M.D.

The Governmental agencies concerned with Veterans' Hospitals are of particular interest to the various specialties. Since the advent of the activities of the Dean's Committee, we have been engaged in organizing the services at Hines Hospital, Maywood, Ill. Hines Hospital has a total bed capacity of 1795, and Vaughn Unit a total bed capacity of 1500. We have seven residents, one senior consultant, five attending otolaryngologists, and occupy 52 beds for the general otolaryngological service and 50 beds for head and neck tumors. One attending otolaryngologist is employed on full time and the others on a half-time basis. The senior consultant examines patients especially selected for his observation and makes weekly grand ward rounds with the entire staff.

During the past year the Department of Otolaryngology has examined 2563 patients for what are known as "P-10" examinations to decide upon admissibility. There were a total of 7632 patients examined, observed or treated by the attending staff.

From the year 1938 up to and including 1946, the eye, ear, nose and throat services were combined. In 1947, the eye service was separated; in that year there were 300 eye operations and 1558 ear, nose and throat procedures, including every form of mastoid bone procedure, bronchoscopy, esophagoscopy, nasal plastics, submucous resections, tonsillectomies, removal of submaxillary glands, laryngofissure, laryngectomy, sinus surgery of all types, frontal bone surgery and all forms of neck infection.

The resident staff consists of men who have completed their basic training in otolaryngology and, therefore, this residency constitutes their second year in the specialty. At this time the residency is limited to one year, but it is contemplated that in 1949 this will be extended to a two-year residency. The work of residents is supervised by attending men who are all members of the University of Illinois faculty. There are numerous conferences, otolarygological, general resident, tumor and departmental. In addition, these residents are included in the residency training program under the supervision of the University. They participate actively in seminars at the University, the Otolaryngological Forum at the Illinois Eye and Ear Infirmary, and in special lecture series arranged in the evening for their convenience.

Intranasal Extension of Pituitary Tumors.

STANTON A. FRIEDBERG, M.D.

(Abstract)

Certain intracranial tumors involving the region of the sella turcica are known to invade the sphenoid sinuses, nasopharynx and nasal passages by direct extension. The most common of these are pituitary adenomas and chordomas.

The case histories of three patients were presented. In each instance, diagnosis of the specific intracranial lesion was made upon microscopic examination of tissue (polypi) removed from the nasal cavity. Two of the patients had typical malignant chromophobe adenomas of the pituitary gland. The third patient was found to have a chordoma of the spheno-occipital type.

Headache, nasal obstruction and excessive postnasal secretion are probably the most common symptoms encountered by the otolaryngologist. Their significance becomes increasingly important with the realization that these same symptoms may be associated with the extracranial extension of sellar neoplasms.

Every patient with a known or suspected lesion of the anterior or middle cranial fossa should have a careful nasopharyngeal examination, this study encompassing the utilization of all available diagnostic aids. Lateral views of the sphenoid sinuses and sella turcica should be included in routine roentgenograms of the nasal accessory sinuses. The necessity for microscopic study of all nasal polypi is again emphasized.

DISCUSSION

DR. THOMAS C. GALLOWAY: Why did you not operate on the second case trans-septally by the method of Hirsch or by Clicari's technic?

DR. JOHN R. LINDSAY: I recall three cases of pituitary tumor in which extension was downward into the nose. In the first one the tumor extended halfway to the vestibule in the septum; in the second and third the nasopharynx was blocked. One, I believe, is living and well today, twelve years after radiation therapy by x-ray. Another was treated about eight years ago by radiation and was living several months ago. The third, on whom we recommended deep x-ray therapy, but who was treated by implantation of radon, died of hemorrhage. These cases were diagnosed as chromophobic adenoma by biopsy.

DR. STANTON A. FRIEDBERG (closing): In reply to Dr. Galloway's question regarding an intranasal approach, there were two reasons why this was not done. In the first place, he was on the neurologic service. A second consideration concerned the areas involved and the mortality rate in surgery of extensive malignant pituitary adenomas, as pointed out by Jefferson. This author reported 33% operative mortality among patients with extrasellar tumor spread. This patient's lesion had extended into the left periorbital space as well as through the floor of the right sphenoid sinus.

Concerning Dr. Lindsay's comment: Irradiation therapy is advocated by most writers for pituitary adenomas which have spread extracranially. One of our patients thus treated lived for four years after the diagnosis of intranasal extension was established. The outcome in the cases described by Dr. Lindsay would seem to further bear out the efficacy of this method.

The case history of the patient with the chordoma is interesting. We were able to remove large masses of chordomatous tissue from the nasal cavity on four occasions over a period of 18 months. This was done with coagulating diathermy because of the extreme vascularity of the tumor and resulted in marked relief from distressing nasal obstruction. After the last operation, the tumor seemed to grow much more rapidly. Necropsy some months later showed tumor extension along the entire basal plate of the skull and into all the paranasal sinuses.

The Posterior Lateral Approach to the Larynx for Bilateral Recurrent Vocal Cord Paralysis

ROBERT B. LEWY, M.D.

The greatest step forward in surgery designed to move laterally one vocal cord in order that the airway might be increased, was accomplished not long ago by Dr. Brien King. It was his concept that orthopedic principles be applied and that the arytenoid be pulled laterally by the action of the transplanted and affixed omohyoid muscle. However, the results of this technic were unsatisfactory in the hands of other surgeons. The principle remained. Thus it was that Dr. Kelly modified this approach and found the arytenoid by making a window in the posterior third of the thyroid ala. He then transplanted it laterally. This has met with considerable success and is still the method of choice of most laryngeal surgeons. This operation still left a good deal to be desired in that there was a considerable percentage of failures; the operation was in a sense destructive as some cartilage had to be sacrificed and, in addition, the operation was not anatomical. Instead of following tissue planes, direct access was accomplished by transecting the thyro-arytenoid and crico-arytenoid lateralis muscles. This was not easy and, therefore, attempts were made to find a more anatomical and less destructive approach.

The approach developed by Woodman (and herein reported) is a more posterior one. Incision is just anterior to the sternomastoid muscle; dissection is then carried down plane by plane until the posterior margin of the thyroid cartilage is exposed. On the most posterior border of the ala an incision is made through the perichondrium and this is elevated anteriorly and posteriorly. The articular facet (the main landmark) of the cricothyroid joint is found and the cartilages are separated with an elevator. The incision is then carried through the posterior portion of the perichondrium and the arytenoid cartilage is exposed. A slit is made in its perichondrium and the cartilage proper is exposed. This is then removed with a punch-biting forceps down to the vocal process. A stitch is placed which goes through the vocal process and part of the vocalis muscle. This is drawn around the inferior cornu of the thyroid cartilage and drawn up, thus pulling over the vocal process and the vocal cord in a manner similar to pulling a boat up to a dock. The stitch is then anchored in the sternomastoid muscle. Closure is by layers; No. 0 chromic catgut is used; the needle is a cutting one, half-inch, half-curved in shape.

REPORT OF A CASE

This 33-year-old white male was admitted to Veterans' Hospital at Hines on July 8, 1947. He complained of weight loss of 50-60 pounds in one year, difficulty in breathing for 6-9 months and twitching and cramps in the legs and arms for a year. He had had a thyroidectomy in March, 1946, with severe respiratory difficulty requiring oxygen immediately following the surgery. He was unable to speak above a whisper for several months postoperatively. He also had difficulty on swallowing. These symptoms grew progressively worse until he sought hospital care.

Physical examination was negative except for a thyroidectomy scar and slight exophthalmos. Blood calcium was 8.6 mg. per cent. Red blood cell count was 2,900,000. Basal metabolic rate was −5. Electrocardiogram showed an increase of the Q-T interval. X-ray studies of the tibia and skull were normal. Laryngeal examination revealed bilateral paralysis of the vocal cords. Shortly afterward a tracheotomy was done, and in the succeeding weeks the patient gained 20 pounds. On September 17 a Woodman modification of the King operation was performed and the postoperative course was uneventful. During this time the blood calcium remained stabilized on 10 grams of calcium lactate daily. Since the operation he has gained more weight; the stridor, dyspnea and dysphagia have disappeared. The airway by indirect view is now adequate and he has returned to his previous occupation of automobile mechanic which his preoperative condition had made impossible.

While this seems a logical approach to the solution of this problem and in this instance was successful, it was by no means easy. The process of getting down to the posterior ala of the thyroid cartilage is a painstaking one and we discovered that the long way around is the shortest way home. There is no doubt in our minds that dissection by layers is quicker and neater than the direct approach we attempted.

We were reminded of the danger of working in this region when the patient developed cardiac arrest. Fortunately this proved temporary, but it indicated the advantage of the use of procaine locally over the region of the carotid sinus when this may be stretched or compressed. It was not easy to expose the arytenoid. Constant and marked tension from the edge of the thyroid cartilage upward was required and the surgeon had to work under a canopy formed by the lateral wing of the thyroid cartilage. Placement of the needle was also difficult; correct placement determines the success or failure

of the procedure. It may prove of value to reverse the course of the needle so that none of the placement will be blind.

Despite these difficulties it is believed that the operation is an improvement over the King procedure. Further testing by a number of surgeons and comparison of results will be necessary to establish this point.

DISCUSSION

DR. PAUL HOLINGER: The approach that has been described is excellent. A new suggestion made by King adds to opening of the airway. He puts a large knot on the suture and as he brings the suture through the arytenoid, the knot has a tendency to bring the arytenoid outward instead of tumbling it in. I believe this improves the airway by rotating the arytenoid into position. I think the suggestion of Galloway and Seed, namely, to remove a portion of the posterior border of the thyroid ala, is excellent, and I wonder if Dr. Galloway will comment on this technic.

DR. MAURICE SNITMAN: At a meeting of this Society several years ago, Dr. Galloway outlined the transthyroid approach. We have carried out this procedure on three cases and obtained satisfactory results in two, where the arytenoid was displaced but not removed.

DR. THOMAS C. GALLOWAY: Dr. Seed and I saw no point in taking out the arytenoid. It is an advantage if you have a window in the thyroid cartilage, to have something to fill the space; and I wonder what the advantage is in removing it, as Kelly and King have done. It serves as a guy to hold the cord out. It is of course important that attachments of the crico-arytenoid articulation be completely freed.

DR. JOHN R. LINDSAY: Has anyone had the experience of obtaining too wide an airway? I have had one case in which, following arytenoidectomy, the patient has more airway than she needs for comfortable respiration. She has air loss in speaking. The arytenoid was removed and the cord retracted laterally by means of a suture passed through it at the point of attachment to the vocal process.

DR. ROBERT B. LEWY (closing): I do not know that I can give a truly competent answer to Dr. Galloway as to why the arytenoid should be removed. I think, however, that if it were not removed in using this technic we would not obtain the desired result. Without separation of the crico-arytenoid joint it would fail.

As to the problem of too wide an airway, we were extremely cautious about that; we did our best to control the situation by a laryngoscope in the patient's mouth and direct observation; we looked in when the knot was tied. The usual failure is when the cord does not go laterally far enough. Then the surgeon may feel it would be desirable to operate on the opposite side as well. This particular difficulty rises much more frequently than the problem of getting too wide an airway. In our patient, for a while after operation, it seemed that the airway was not adequate. It was not until five weeks later that we were satisfied that we had accomplished what we started out to do.

Clinically Malignant Tumors in Otolaryngology

MAURICE F. SNITMAN, M.D.

(Abstract)

Malignancy is not a synonym for cancer. It refers to the harmful effects of any tumor, whether histologically benign or malignant. There is, fortunately, an increasing tendency to restrict the term malignancy to new growths that are essentially deleterious to the host. The important features of such growths are infiltration, local destructive properties, recurrence after incomplete removal, interference with function and general toxic action of the absorbed tumor products. Tumors classified as benign possess almost all these features, and this fact is not sufficiently appreciated.

Neoplasms such as nasopharyngeal fibromata, nasal papilloma and chondroma present problems of therapy the magnitude of which is comparable to that of carcinoma and sarcoma. Inadequate treatment of such lesions will frequently prove fatal.

A not uncommon lesion is the salivary gland tumor. This designation does not fully imply its true malignant potentialities, and the need for radical therapy is not generally appreciated. It has been our experience that clinically malignant tumors that do not bear the label of cancer or sarcoma do not receive the serious consideration they merit.

We wish to present three cases that in some measure bear out these points:

Case 1, H. R.: Male, aged 39. First seen by an otolaryngologist in April, 1943, because of nasal obstruction. This was caused by a tumor in the floor of the left side of the nose. Tissue biopsy

showed chondroma. Local surgery was performed which proved inadequate. In December, 1943, x-ray studies showed the hard palate to be eroded. Between 1943 and the latter part of 1947 he underwent several surgical procedures which again proved inadequate. In October, 1947, examination at the Research and Educational Hospitals disclosed extensive destruction of the left upper maxilla with involvement of the orbital floor and pterygopalatine fossa. Radical resection was attempted but the lesion was found to be too extensive for safe surgery.

Case 2, G. B.: Male, aged 65. Examination in August 1947, at Hines Veterans' Administration Hospital disclosed both sides of the nose filled with polypoid tissue; in the glabellar region there was a fistula about 2 x 3 cm. in diameter, which led into the frontal sinus and was filled with polypoid tissue similar to that in the nose. In 1934 he had first experienced obstruction in the right side of his nose. The polyp was removed and biopsy study disclosed a precancerous or carcinomatous degeneration. A radical antrotomy was performed on the right side and subsequently he underwent 24 antranasal polypectomies. In 1939, an external frontal operation was performed; after healing, the area of the operative site broke down and produced a fistula. Because of the extension of the lesion it has been necessary to perform a radical exposure of the frontal area and destruction of the tumor mass by electrocoagulation. The cribriform area of both sides has been entirely destroyed, but the dural surface of the anterior fossa of the skull is well protected by scar tissue formation. Electrocoagulation of residual tumor mass has recently been performed and on last examination there appears to be only small remnants of tumor tissue.

Case 3, H. W.: Male, aged 54. In February, 1943, he complained of nasal obstruction. Examination showed a tumor mass filling the right nasal cavity, biopsy study of which revealed a salivary gland tumor of the basioloma type. Surgery was refused and a course of x-ray therapy was given over the next few years with resultant regression of the tumor mass. The patient was not seen until February, 1947, with enlargement of the tip of the nose and shortness of breath associated with cough. Chest study showed both lung fields extensively involved by metastases.

From the above, it appears that most benign tumors of the head and neck, although they do not bear the terms carcinoma or sarcoma, merit efforts of therapy commensurate with those used in carcinoma and sarcoma. Most histologically benign tumors if inadequately treated will, in many instances, prove fatal.

The Otologic Effects of Streptomycin Therapy

LINDEN J. WALLNER, M.D.

(Abstract)

Ear examinations were made on 93 patients receiving streptomycin at Hines Hospital. They are divided into two groups according to dosage. Group I received 2 grams per day for four months. Group II received one gram per day. Audiograms and caloric tests were made before, during and after treatment.

One patient with anuria suffered almost total loss of hearing; no other patient was found to have any hearing loss from the drug.

Of the 53 patients in Group I, 42 noticed subjective symptoms of dizziness, staggering gait or visual disturbances, and 25 had objective evidence of depressed or absent vestibular function. Of the 40 in Group II, 18 complained of subjective symptoms and 13 had depressed or absent caloric response. No return of function was noted later in those with absent responses. They also continued to have subjective complaints, trouble on walking in the dark, and dizziness, though these symptoms became less bothersome. These patients were grateful for the improvement in their general condition and did not seem to feel the vestibular disturbances were too high a price to pay for it.

DISCUSSION

DR. SHERMAN SHAPIRO: I think one of the most interesting things about this paper is that there is shown for the first time the effect of something analogous to the experimental exclusion of both vestibular impulses in animals, practiced by McNally and other investigators. However, my idea is that in Dr. Wallner's patients, this takes place at a higher level than the internal ear, somewhere in the central vestibular area. I would be interested to see how long these disturbances last. If we judge from the effects in congenital deafness there should be sufficient compensation in time for these people to function in a normal way. One thing to know is whether or not there has been any change recently in the method of producing streptomycin. It is not impossible that the toxic effects may be due to impurity in manufacture rather than in the drug itself.

DR. PAUL CAMPBELL: I would like to mention two things. The toxicity of streptomycin seems to be due to the ratio between intake and excretion. In regard to Dr. Wallner's case in which

there was anuria, I think it has been proven that in four hours' time the streptomycin level can reach a point at which it can destroy the vestibular apparatus. The internists do not seem to understand what a serious thing loss of the vestibular function is. They seem to think it will soon be compensated for; however, this is not true. I do not think such people could work on a roof or scaffold; I certainly would not want them on my roof at my responsibility.

DR. JOHN R. LINDSAY: At the Eastern Section Triological Meeting report was made that if dosage of streptomycin was kept below 19 mg. per kilo of body weight per day, it would not be likely to cause vestibular signs. Yet, according to Dr. Wallner, some patients do get vestibular signs. Dr. Hawkins of Merck & Co. pointed out that certain animals not only lose the vestibular response following streptomycin therapy but have loss of optokinetic nystagmus as well, which would indicate more widespread central damage.

DR. LINDEN WALLNER (closing): I cannot answer Dr. Shapiro's question about possible impurities. The patients in this report received the drug over an 18 months' period, so that a number of different batches must have been used.

Subjective complaints were noted in about three weeks, but it was about two months before there were absent caloric responses.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

Meeting of Monday, April 5, 1948

THE PRESIDENT, DR. JOHN R. LINDSAY, IN THE CHAIR

The Development of the Auditory Ossicles and the Temporal Bone (A Summary of Research)

BARRY J. ANSON, PH.D.

(Abstract)

(This paper appeared in full on page 603 of the September 1948 issue.)

DISCUSSION

DR. ELMER W. HAGENS: Dr. Anson has given us another of his illuminating papers on developmental anatomy of the ear. As otologists we are fortunate in having in our midst someone who is not only capable, but sufficiently interested to give us the results of his research in our field.

Some years ago I had the opportunity of studying the development of the human ear in a group of fetuses at the University of Chicago. My series was not nearly as complete as Dr. Anson's, nor did I have the opportunity to study the material in detail. However, I did find many of the structures he has mentioned, and can appreciate the labor and care that has gone into his investigation. A number of the facts brought out may have a relation to our clinical findings. For example, the head of the stapes in the early stages is connected with the hyostapedial tissue from which the stapedius muscle and tendon are derived. In one of four cases of malformation that I have studied, the malleus, tensor tympani muscle and incus were present while the stapes and stapedius muscle were absent. In a second case, the malleus, tensor tympani muscle and incus were absent, while the stapes and stapedius muscle were present. These findings can be correlated with the development of the ossicles as presented by Dr. Anson. Cases have been reported of malformation of the stapes, so that only one incus extending from the center of the footplate was

found. I wonder if Dr. Anson would have any idea as to how this could occur. I believe his findings of the double origin of the stapes is an important contribution; it makes the development of this ossicle much more understandable.

In the development of the ossicles it is noted that the malleus and incus contain marrow, while the stapes, when fully developed, does not. In examining sections of the temporal bone having a history of otitis media, I have found infection extending into the marrow cavity of the incus from the tunica propia of the mucosa. In other sections the stapes is found completely embedded in infected tissue, but the outlines of the ossicle can still be seen. Due to the difference in anatomy, infection may affect the malleus and incus in one manner, and the stapes in another. Otosclerosis frequently involves the stapes, whereas, except for one or two reports in the literature, otosclerosis has not been found in the malleus and incus. Whether the anatomy of the particular ossicle has anything to do with this is problematic, but one may speculate on it.

Study of the three layers of the bony labyrinth has assumed increasing importance due to the fenestration operation. Experiments are going on at present as to the best method of making the fenestra remain open, but the final solution is yet to come. Careful studies such as these of Dr. Anson's may reveal clues that will help in finding the answer to the fenestra operation.

It is interesting to note that, while the petrosa is different from all other bones in that its enchondral layer contains cartilaginous rests and other islands of cartilage, this is the layer where otosclerosis usually begins. Furthermore, otosclerosis does not occur in other bones, nor has it been found in animals. Dr. Bast, one of Dr. Anson's co-workers, has found the fissula ante fenestram only in the human temporal bone; also, he has noted that otosclerosis, starting at the "site of predilection", begins in the secondary cartilage formation about the fissula. Finally, the fissula becomes obliterated and, he feels, this may possibly produce deafness by obstructing the perilymph filtering function of the fissula. Thus we find otosclerosis—which is found only in the human and only in the temporal bone—beginning usually in tissue about the fissula ante fenestram which is, itself, only found in the human.

Whatever the true relationship and importance of these findings may be, it is evident that studies of the temporal bone such as these are of great interest to otologists, and may well lead the way to a solution of some of our baffling clinical problems.

DR. BARRY J. ANSON (closing): In addition to thanking Dr. Hagens for his generous comments, I would like to emphasize one point. From the developmental standpoint, the ossicles should not be regarded as bones which follow a similar pattern of morphogenesis. The malleus and incus resemble a miniature tibia; their development schema matches that of a typical long bone, despite the fact that they are derived from the branchial arch skeleton. The stapes, although likewise originating at least in part from an arch, does not conform to the "standard" pattern. The stapes (closely related in its basal portion to the otic capsule) undergoes profound alteration in form after it has been fully formed in cartilage; the bone of the ossicle is removed continuously on the obturator aspect with, concurrently, negligible production of intrachondrial bone within its crura. It loses approximately half of its bulk while attaining adult form and size in the fetus. Its unusual developmental history would be expected to make a difference in any pathologic change which it might later manifest.

Intranasal Medication with Vasoconstrictors

O. E. VAN ALYEA, M.D.
AND
ALLEN DONNELLY, M.D.

(Abstract)

An investigation was carried out at the Research Hospital, University of Illinois, to determine the effects of nasal vasoconstrictors on cases of hypertensive, cardiac and thyroid disorders, and diabetes mellitus. This investigation was prompted by the fact that the Federal Food, Drug and Cosmetic Act requires a "Warning" on bottles containing ephedrine or vasoconstrictors of similar character. This warning reads: "Caution: Frequent or continued use may cause nervousness, restlessness or sleeplessness. Individuals suffering from high blood pressure, heart disease, diabetes or thyroid trouble, should not use this preparation except on competent advice."

This study was made on 11 patients with hypertension, 16 with cardiac disorders, 9 with thyroid disorders, and 14 with diabetes. After a complete examination the patient was placed in the head-low position on an examining table, and five drops of a vasoconstrictor was instilled into each nostril. The position was maintained for several minutes, then the patient was returned to the sitting posi-

tion. Pulse and blood pressure readings were made at intervals up to 45 minutes. The testing solution applied was one in common use, neosynephrin, in the strengths of 1% and ¼%.

No untoward effects were noted and it was thought by the investigators that absorption from the nasal membranes is entirely too retarded to be of consequence in development of side effects, and it could be assumed that when such do occur it is due to absorption of the drug from the stomach, when inadvertently swallowed.

In view of this, and the results of the present investigation, it is felt by the writers that in the application of intranasal medication with vasoconstricting solutions no distinction need be made between patients suffering from organic disorders and those without, and that the warning called for by the Federal Food, Drug and Cosmetic Act is unwarranted. A substitute warning, should one be required, could well read: "For nasal medication only. Do not swallow."

DISCUSSION

DR. CARL C. PFEIFFER: This courageous study by Dr. Van Alyea and his associates is meritorious, and one that should be called to the attention of the Food and Drug Administration regarding their label warnings. They are a relatively small scientific group in Washington; they do not have on their staff any member of a specialty group such as yours; they cannot make experiments. Nevertheless, we must point to the good things they have done. They have been instrumental in stopping the marketing of vasocinstrictors suspended in mineral oil. They have prevented the toxic effect of many other drugs which would have been foisted on the unsuspecting public. They are not concerned with the therapeutic merit of a drug, only its possible toxic effect.

With regard to nasal vasoconstrictors, the history of the use [illegible] compounds has been rife with minor toxicity. We know that epinephrine produces a reactive hyperemia which is worse than the primary condition. We know that argyrol may produce argyria and that it will also destroy the cilia of the nasal mucous membrane. We know the use of ephedrine in oil may give rise to lipoid pneumonia in children when the oil drains into the lung. We know that nasal vasoconstrictors, particularly oil of eucalyptus or menthol, will congest the nasal mucous membrane. Chlorotone or chlorobutanol paralyzes the nasal cilia. So there are still harmful medications on the market. The use of privine, as Dr. Van Alyea said, may produce

reactive vasodilation. Amyl nitrite or organic nitrites when applied to mucous membranes are promptly absorbed, but with the water soluble vasconstrictors there is decreased blood supply, and little is absorbed in the mucous membrane. The greatest systemic danger comes from swallowing vasoconstrictor compounds which are not destroyed in the stomach; neosynephrin is, ephedrine is not. We have looked for vasoconstrictors which are without central stimulation.

Dr. Van Alyea's study has gone a long way in reassuring us that vasoconstrictors can be applied to the nasal mucous membrane without fear of complications as long as the medication is not swallowed. If this study is brought to the attention of the Food and Drug Administration they will undoubtedly modify their labeling requirements.

DR. ALFRED LEWY: In view of the fact that one proprietary produce was brought out prominently in this investigation, and further in view of the fact that Dr. Pfeiffer has mentioned two others as having similar effects, I would like to ask if he has a more complete list of proprietaries that can be used without danger of absorption from the stomach or central stimulation. If we go into the matter of proprietary medication at all, I do not think we should advance one above the other.

DR. JOHN R. LINDSAY: You have mentioned that many patients have suffered from the prolonged use of privine. It would seem reasonable that the authorities should warn against the use of such a drug for prolonged periods except under the advice of a physician.

DR. CARL C. PFEIFFER: Most of the proprietary medications that are not specialties of given pharmaceutical houses contain 1 to 3% ephedrine; five drops of a 3% solution would provide about 10 mg. of ephedrine, and if repeated often this would be an effective systemic therapeutic dose. The only nasal constrictor which is now known to be destroyed in the stomach is neosynephrin. It is true that the Stearns Company had an elixir of neosynephrin which they marketed, but this has been discontinued. Even their ampouled solution supplied for intramuscular injection will be destroyed within a week if any metal comes in contact with it. This occurs the first time a hypodermic needle is used to remove a dose from a vial. So these vials should not be used for more than one week. That is true also of the metal atomizer; neosynephrin will be slowly destroyed unless an all glass atomizer is used.

DR. O. E. VAN ALYEA (closing): As I mentioned in the paper, this is not a complete study. We hope to carry out a similar investigation using ephedrine, although I doubt if we will use privine. The paper was not intended to impress the Federal Food, Drug and Cosmetic group, but we thought it a subject which would be good for investigative purposes in view of our experience with the use of drugs applied locally in the nose.

Hand-Schüller-Christian Disease and Eosinophilic Granuloma of the Skull

HAROLD F. SCHUKNECHT, M.D.

(This paper appeared in full on page 643 of the September 1948 issue.)

DISCUSSION

DR. H. B. PERLMAN: From a purely clinical standpoint, our experience emphasizes that it is easy to overlook the true nature of the lesion, especially when infection is superimposed. This was true in all our cases involving the ear. The first two were operated on and some of the removed material was examined histologically without recognizing the underlying disease process. The original impression was of ordinary inflammatory granulation tissue; only after other bone lesions developed was the original mastoid lesion suspected. Then a careful search through all the histologic material removed at time of operation revealed the characteristic picture in areas not directly involved in the acute inflammatory response. This indicates that in an infected lesion all the tissue removed must be carefully examined, preferably by a trained pathologist who is familiar with the histologic variations in different phases of this disease. The fact that the original ear lesion may have healed, and that the patient may have been discharged before a lesion develops elsewhere in the body, also contributes to inaccurate diagnosis. Considerable time may elapse before a new lesion develops, and the patient now seeks relief of shoulder pain, for example, because of a lesion in the scapula. Superimposed infection of a lesion, especially where complications are present as in our first two mastoid cases, requires complete surgical exenteration.

In the noninfected cases, however, as in our third ear case, complete operative removal is contraindicated and can be prevented if

tissue is available for histologic examination. This may be easily accessible in the external canal, as in our case, or may require mastoid biopsy. This lesion is very sensitive to x-ray and begins to heal shortly after a small dose. This response can be useful for differential diagnosis. Even the noninfected cases may produce a picture resembling that of simple suppuration. Thus, the youngster brought in because of a discharging ear was treated as a simple suppurative otitis both by the pediatrician and by the otologist for several weeks. Recurrent granulation in the canal and a full red drum without landmarks were apparently compatible with such a diagnosis. However, careful examination while under anesthesia for removal of aural granulation failed to reveal perforation of the drum. The source of granulation was found to be a defect in the floor of the bony canal just external to the drum. The opposite drum was full, red and devoid of landmarks, but there was no discharge nor granulation in that canal. Mastoid x-ray pictures were made, and were reported by a junior roentgenologist as showing simple bilateral clouding of small mastoids. Actually the pictures showed such extensive change in density far beyond the limits of both mastoids that it was considered as normal background, against which the involved dense bone of, and adjacent to, the capsule was viewed. Of course it is easy to look back after the diagnosis is made and point to the features of the case which set it apart from an ordinary case of otitis media. Insidious, painless onset and recurrent abundant granulations are significant.

Many diseases have to be considered in differential diagnosis. In a child recently examined, extensive destruction of the base of the mastoid in relation to the jugular foramen with seventh, tenth and twelfth nerve paralysis was due to a nerve cell tumor. This could be biopsied through the floor of the external canal, into which the tumor had grown.

The whole group of apparently related diseases considered in this presentation is very poorly understood. They appear to be, at least in part, concerned with disorders of fat metabolism. Enzyme systems of the cell controlling this fat metabolism are probably involved. Perhaps some of the newer histologic technics for demonstrating the effect of some of these cell enzymes may throw some light on this aspect of the problem.

However, there are some features that suggest that we are dealing with an infectious process. Further information might be obtained by exhaustive study of the material removed from a noninfected lesion such as one sees in the calvarium or near the frontal

sinus. Complete aerobic and anaerobic cultures and inoculations into eggs should be done, along with inoculations into the anterior chamber of the eye and preparations of sterile extracts for skin testing. Anyone preparing to operate on such a lesion should mobilize the resources of the bacteriology and pathology departments for this type of study.

DR. LAWRENCE J. LAWSON: I wish to present briefly the record of a woman aged 51; the progress of the disease is readily shown in the seven slides presented. The right eye was glaucomatous and had a cataractous lens, so that it was impossible to see the fundus. The left fundus was very anemic and there were several episodes of dimming out of vision. This was followed by complete blindness and optic nerve atrophy. There was complete loss of hearing in the right ear and about 80% loss in the left ear. The patient's adherence to Christian Science interfered with observation and therapy.

The seven slides demonstrate the progress of resorption of bone in the pituitary region and the right temporal bone in a typical instance of Hand-Schüller-Christian disease. The first slide shows marked thinning of the posterior clinoid processes. In the following six slides, progressive destruction of the sella turcica, clinoid processes and posterior walls of the sphenoid sinuses is seen. Concurrently there is progressive resorption in the right temporal bone.

There was confusion in the early stages regarding the diagnosis. It was first believed to be a pituitary adenoma. The right eye was glaucomatous and a consulting ophthalmologist strongly considered the presence of an intraocular tumor with intracranial extension. Another consultant felt that it must be an intracranial extension from a nasopharyngeal transitional cell carcinoma. Deep x-ray therapy was given. The patient has remained well nourished. She is blind and deaf. No recent x-rays are available at this time.

DR. ELMER W. HAGENS: I should like to record the case of a child 22 months of age who was brought into the clinic at Northwestern University Medical School with a history of recent indefinite discharge from one ear. On examination we found a large polyp blocking the external ear canal making it practically impossible to see the drum. X-ray showed a definite punched-out area in the region of the mastoid, with the report that it was unusual although its significance was not determined. We treated it as a mastoid and at operation it was decided to take out the polyp first. It proved to originate on the posterior wall and the drum looked intact. One pediatrician had said he had incised the drum. Following removal of the polyp, when the mastoid was examined no cortical

bone was found; there was a grayish-white tumor mass which was enucleated as carefully as possible. The bone over the sigmoid sinus was gone, also that of the posterior wall of the external canal down to, and including, the anticus tympanicus. The tissue apparently went down to the seventh nerve but a line of cleavage was made superficial to the facial nerve. Most of the tissue was removed, leaving a little over the sigmoid; the sinus was normal except where the tumor was attached. The wound was closed and healed well and promptly; the child developed facial paralysis the next day, which has now practically cleared up.

Our pathologist at Wesley Hospital has written an article on eosinophilic granuloma, and he believes this is what was present in this case. We hope the child will get along with x-ray treatment. This is the only lesion that is apparent. We were glad we did not go too close to the facial canal, because apparently the tissue was in contact with the facial nerve. No particular infection was noted; the polyp was apparently part of the process which had grown through into the external canal. Bacterial studies were not significant, and, with the pathologic diagnosis, we felt that the area was not infected. It is easy to assume that one is dealing with a mastoiditis, especially if a polyp is present, and yet such cases can prove to be tumors.

DR. M. A. GLATT: About four years ago I presented a case of xanthoma-lipoid granuloma of the temporal bone before this society, and discussed the difficulty of preoperative diagnosis when the symptoms involve only the temporal bone. In the presence of suppuration it often resembles Pneumococcus Type III infection. If suppuration is absent it is difficult to differentiate it from malignancy, tuberculosis, or other types of bone lesion.

In the young, when the skull lesion is associated with signs pointing to involvement of the pituitary gland, it has been known as Hand-Schüller-Christian disease. None of these authors had a knowledge of the pathology of the disease. Fundamentally, it is a disturbance of the fat metabolism in the affected reticulo-endothelial cells which form the granuloma and is not caused by disturbance of the general fat metabolism. Such a disturbance can involve any organ of the body. Customs and traditions are not easily discarded, and thus it becomes difficult to dissociate xanthoma lesions of the skull from Hand-Schüller-Christian disease, even though the pituitary symptoms, the most important, are absent.

The essayists are fortunate in having had the opportunity to see such a large number of cases, as they are extremely rare in ordinary

practice. In presenting the first phase of the disease as eosinophylic granuloma they appear to give us a study of an extremely early stage which possibly presents little symptoms. However, the later phases, as Letterer, Bois, Hand-Schüller-Christian and the final phase of fibrosis, seem to add to the already existing confusion in classification. I should like to see it more clarified and simplified.

DR. HAROLD F. SCHUKNECHT (closing): All our cases of eosinophilic granuloma were treated surgically; x-ray irradiation is an equally good treatment. Common procedure is to establish diagnosis by frozen section biopsy and to curette away the lesion at the same operation. Lesions which develop subsequently can be irradiated.

Dr. Lawson's patient with an extensive lesion of the base of the skull is probably a case of Hand-Schüller-Christian disease. The term eosinophilic granuloma should be reserved for those cases having a milder course and consequently a better prognosis.

A monosymptomatic early stage of Hand-Schüller-Christian disease has been known to exist for many years. Several reports on solitary granulomas appeared in 1940 and, since then, the descriptive term eosinophilic granuloma has been in common use. In 1942 its relationship with Hand-Schüller-Christian disease and Letterer-Siwe disease was emphasized by several investigators. In Dr. Hagen's case there was a destructive lesion of the mastoid, an intact tympanic membrane and granulations in the external ear canal. Two of our cases presented similar findings. Hand-Schüller-Christian disease is always suggested by this clinical picture. The bony facial canal is often eroded away in these cases. Surgery of the mastoid in these cases is best directed only at establishing diagnosis by biopsy or to treat complicating infections. Attempt at complete curettage is hazardous; x-ray therapy is the treatment of choice.

There is nothing about the radiographic appearance of the lesions of eosinophilic granuloma or Hand-Schüller-Christian disease which will differentiate them from each other or from several other conditions. In differential diagnosis one must consider primary and metastatic carcinoma, primary and secondary cholesteatoma, osteomyelitis, multiple myeloma, tuberculosis, syphilis and fundus lesions. I believe, Dr. Glatt, that there is fairly universal agreement that these diseases are all manifestations of a common disorder. Improvement in terminology probably must wait until the etiology is discovered.

Abstracts of Current Articles

EAR

Problem of the Congenitally Deaf Child.

MacFarlane, D.: J. A. M. A. 137:774-775 (June 26) 1948.

A child who is deaf at birth or becomes deaf before the age of two does not learn languages and speech. The author has found in a series of over 50 patients that 90% of these children have usuable hearing. Hearing can be reached by amplified sound. Most of them can be taught to understand the spoken word by hearing and can be taught to speak intelligently. A hearing aid should be tried even on the apparently hopelessly deaf child. Training in a conditioned response will not only improve the behavior and attention but will permit a quantitative hearing test. It is highly advisable to prepare these children to enter the schools for children with normal hearing, avoiding institutionalizing, if results warrant it. Normalcy in growing up is most needed in any handicapped child.

BOIES.

Surgery of the Seventh Nerve.

Tickle, T. G.: J. A. M. A. 136:972 (April 10) 1948.

The author draws on his experience of 16 years in the observation of several hundred cases of facial paralysis. He states that he not only relies on the patient's reaction to faradic stimulation, but on his own experience. A patient with paralysis of the facial nerve in which response to faradic stimulation has been lost, and the angle of whose mouth in repose is drooping, in the author's opinion should have the advantage of surgical treatment. Usually the angle of the mouth on the paralyzed side is lower than on the nonparalyzed side in a complete paralysis of the facial nerve, but when the angles are about even it signifies that there is a slender connection between the nerve segments above and below the site of injury; in other words, there is enough connection left to supply tonus to the oral muscle. The author has seen a number of patients

in whom the response to faradic stimulation was lost, regain their voluntary motion in a few months. In these cases the history of the paralysis is of great importance. Complete facial paralysis immediately after either simple or radical mastoidectomy nearly always means that the nerve has been badly damaged or severed, while that coming on several hours or days after the operation means that the nerve has been injured either by slightly tearing the sheath and injuring a few neurons, by pushing a spicule of bone into the nerve or by hematoma in the nerve sheath which creates an edema of the nerve, the swelling of which shuts off the impulses going from the brain to the periphery. In those cases in which paralysis appears immediately after simple or radical mastoidectomy, and in which response to faradic stimulation is lost within 72 hours, the nerve should be uncovered and inspected. In this surgery the author believes that it is important to use some sort of magnifying loupe or magnifying glasses when uncovering and inspecting the nerve.

Preoperative paralysis of the facial nerve in the case of acute otitis media is of itself no indication for operation, any more than are cases of so-called Bell's palsy, because the paralysis is usually due to edema or toxic neuritis; however, if there is a quick loss in faradic response, and any indication of a mastoid involvement, then operation is clearly indicated. A simple mastoidectomy should be performed without a decompression of the facial nerve. Should the paralysis still persist after a period of two months following the simple mastoidectomy, then decompression of the facial nerve should be considered. In cases of chronic suppurative otitis media the situation is quite different. The author concurs with others that a radical mastoidectomy is indicated. If there is a loss in response, a fistula in the facial canal, and any signs of an osteitis, the surgeon is justified in uncovering the matter. In the cases in which a decompression is performed, the author thinks it should be uncovered from the stylomastoid foramen up to the geniculate ganglion and the sheath slit over the entire exposed nerve.

In cases in which the nerve has been injured in any way from trauma, the author prefers a nerve graft. The type of nerve used for graft is of no consequence. The size of the nerve is important because, if too large a nerve is used, the end results are apt to be less satisfactory. In cases where a small trand of nerve is left, it is desirable not to remove it, but to slit the sheath above and below the injury and insert one or more strands of the nerve. The author has found that glue to fasten the ends of the nerve together is not necessary because there will be some bleeding at the time of the graft,

so the patient furnishes his own "glue" which is just as good as any that is artificial. In the matter of "Bell's palsy," the author believes that all patients who lose response to faradic stimulation and show no improvement in six weeks should have a decompression operation. The nerves should be uncovered and the sheath slit from the stylomastoid foramen to the horizontal semicircular canal. As a matter of postoperative result, the function of the frontalis muscle practically never returns, the explanation for which is supposed to be that the fewer contractile elements present in the frontalis muscle degenerate before innervation has been reestabilshed.

BOIES.

On Cysts and Infarcts Occurring in Stria Vascularis.

Saxen, Arno.: *Acta Oto-Laryngologica* Suppl. LXVII, 1948.

On the basis of two cases with histological specimens, the author discusses the genesis of infarcts and cysts in the stria vascularis of the inner ear. He describes the condition of angiosclerosis in the end arteries of the stria of old people and shows that this leads to limited areas of necrosis in the stria epithelium. These necrotic areas correspond to our general conception of infarcts. They may further develop into cysts which protrude into the cochlear duct. The histological specimens are clear, and the explanation of the findings are well presented.

SATALOFF.

Attic Cholesteatoma Following Longitudinal Fracture of the Pyramid.

Nilsson, Gunnar.: *Acta Oto-Laryngologica* 36:Fasc.1, 1948.

A brief account of the development of the Habermann-Bezold cholesteatoma theory is presented, along with the modern classification of true and pseudocholesteatoma. The possibility of cholesteatoma formation on the basis of fracture of the pyramid without any accompanying mastoiditis is suggested.

The author presents a case of fracture of the pyramid with ensuing cholesteatoma in which the mastoid cell system was found to be entirely normal at operation. He suggests that this cholesteatoma developed solely as a result of the direct ingrowth of the epithelium through the fracture into the middle ear.

Some Orientating Remarks on Tuning Forks and Audiometer and on the Registration of Defects of Hearing.

Mygind, S. H.: *Acta Oto-Laryngologica* 33:Fasc.1, 1945.

Several cases are cited to show that the old rule that conductive deafness is characterized by low tone loss, and perceptive deafness by high tone loss, holds true only when using tuning forks. This rule does not apply when using an audiometer unless decibels are converted into sons, the biological measurement, using as a basis Fletcher and Munson's "Equal Loudness Curves".

A brief discussion of the relations of physical energy and biological loudness is presented. In conclusion, the author states that the accuracy of the tuning fork and monochord is no less than that of the audiometer, and all should be used in testing hearing.

SATALOFF.

Facial Paralysis In Otology.

Farrior, J. B.: *Southern M. J.* 41:348-356 (April) 1948.

The author presents a comprehensive paper on facial paralysis in otology and reports eight cases of his own.

He gives a very accurate description of the anatomy of the facial nerve in its tortuous course through the temporal bone.

The author states that the intratemporal operations on the facial nerve include simple decompression, decompression and end anastomosis, rerouting and end-to-end anastomosis or decompression and nerve grafting.

Facial paralysis resulting from basilar skull fractures may be amenable to otologic surgical treatment if the lesion involves the middle ear. Exploration should be considered when there is loss of response to faradic stimulation.

Facial paralysis developing early in the course of acute otitis media and mastoiditis will usually respond to management of the primary pathologic process.

Facial paralysis occurring during the destructive stage of acute mastoiditis or in chronic mastoiditis demands immediate surgical intervention.

Delayed facial paralysis developing in the postoperative period of any otologic operation should be treated conservatively unless there is loss of response to faradic stimulation.

Immediate facial paralysis developing during any otologic operation demands immediate exploration and should never be treated by hopeful expectancy.

Restoration of the continuity of the facial nerve itself is indicated if the cut ends of the nerve are accessible and the muscles of the face are contractile.

The importance of facial paralysis has been greatly overstressed as a possible sequel of the fenestration operation.

Decompression of the facial nerve may be indicated in those cases of Bell's palsy which show loss of response to faradic stimulation for six weeks.

TAYLOR.

Cerebrospinal Meningitis and the Acoustic Function.

Johnson, Sfeen: *Acta Oto-Laryngologica* 36:Fasc.2, 1948.

The author performed audiometric tests on and evaluated the auditory acuity of 33 patients of proven meningococcic meningitis. Twenty-three of these cases were treated with sulfonamides while ten occurred prior to the use of these drugs.

Five cases, or 15%, of the total showed hearing impairment. Although the cases are too few to be of statistical value, the author feels that hearing impairment from meningitis has become less frequent since the introduction of sulfonamide therapy.

He deduces that deafness from meningitis comes early in the disease, is usually bilateral and profound and is due to labyrinthine involvement.

SATALOFF.

A Method of Radical and Radical Conservative Operation Adopted in the Clinic of Cracord.

Miodonski, J.: *Acta Oto-laryngologica* 36:160, 1948.

A combination of local and intravenous anesthesia is routinely employed. The author describes his incision which is postauricular and without posterior periosteal elevation. The membranous external meatus is cut transversely so as to preserve all connections of

the inner lining and the drum. After the indicated operation in the bone is completed, this portion of the canal epithelium is "pedicled" to fit the individual case. This has certain resemblances to the incision reported by the late Campbell Smythe.

HILL.

What Can One Do For the Hard of Hearing. A Panel Discussion.

Lederer, F. L., et al: J. A. M. A. 137:1120-1127 (July 24) 1948.

This is a discussion by well-known experts in the field of the rehabilitation of the hard of hearing. Canfield, Thompson, Koepp-Baker, Pauls, Truex, and Kinney, participate.

In the fitting of hearing aids the need is emphasized for a medical and psychosocial analysis of the patient; also, that there be psychologic preparation of the patient in advising him as to what he may actually expect. A testing of various hearing aids is important. The hearing aids of different companies have different tonal qualities; some are sharp, others are mellow, others are hollow. It is essential that this quality in hearing aids be acceptable to patients, for it is essential to their comfort. Koepp-Baker outlines auditory training under three heads. First, the preparatory state or period in which the patient is helped to understand what will be expected of him when he is being measured for determination of hearing loss, and what he is going to do with the amount of hearing he has left. Second, the preparation in three major steps: telling the patient what he needs to know; helping get the facts and instructing him in regard to the instrument; and developing an attitude toward its use. Third, helping the patient to become skilled in the use of the aid.

Pauls stresses the importance of the ability of the patient to use lip reading and states that the solution for most persons is that combination of well-selected hearing aids and speech (lip) reading which enable them to communicate most freely and easily.

Truex told how the instrument, method, and procedure can be made practical for the otologist and discussed the role of general otologic treatment in aural rehabilitation. He stated that the treatment of lymphoid hyperplasia in children sometimes produces dramatic results and that the fenestration operation on properly selected cases has a definite but limited value. However, it is a fact that the large majority of the adult deafened still have to rely on hearing aids and speech reading for their rehabilitation.

Kinney pointed out the responsibilities of the otologist in the organization and establishment of an aural rehabilitation program in his community. He discussed the available community resources and their coordination, and pointed out the need of research.

BOIES.

NOSE

Spontaneous Cerebrospinal Rhinorrhea.

Dohlman, G.: Acta Oto-laryngologica Supple. 68:20, 1948.

A case of cerebrospinal rhinorrhea, operated upon by an external fronto-ethmoid approach, is reported. The fluid appeared to be coming from the roof of an ethmoid cell. This was closed by a piece of muscle, covered with a mucous membrane flap, but leakage continued. Cystachrome was then injected intrathecally, staining the cerebrospinal fluid blue. This indicated the site as mesial to the middle turbinate. Reoperation was performed through the old incision with removal of the cribriform plate and elevation of the dura. The dural defect was closed and covered with muscle, after which mucous membrane flaps from the septum and middle turbinate were brought together and held in position with a penicillin and sulfonamide dressing. Recovery was uneventful.

This method seems to offer no advantages over the usual neurosurgical procedures and to present certain increased hazards. The report emphasizes the value of staining the cerebrospinal fluid to determine the site of the fistula.

HILL.

PHARYNX

A Case of Primary Nasopharynx Tuberculosis?

Wille, C.: Acta Oto-laryngologica 36:63, 1948.

The author presents a case of a boy with a nasopharyngeal tumor which microscopy indicated to be of tubercular origin. No other evidence of tuberculosis was noted. Inasmuch as no tubercular bacilli were found, nor were guinea pig inoculations positive, there is not sufficient evidence to justify the diagnosis of such an extremely rare condition. Boeck's sarcoid would seem a more likely possibility.

HILL.

On the Treatment of Nasopharyngeal Fibroma and its Results.

Hërkönen, M., and Malmio, K.: Acta Oto-laryngologica Supple. 68:33, 1948.

The results of the treatment of 31 patients are reported. Four cases with narrow pedicles were managed by operation alone; eleven, with operation and roentgen and radium therapy; and 16 with either roentgen or radium, or both. Results were satisfactory in all cases although treatment was not completed in eight. Operation may be beneficial in pedunculated cases by shortening the duration. The risk of complications is lessened by the use of radon implants. Ligation of the external carotid did not seem to have any definite effect in hemorrhage. These conclusions seem to be in accord with the reports of American investigators.

HILL.

The Question of Local or General Anesthesia in Tonsillectomy, with Special Reference to the Frequency of Certain Complications.

Key-Aberg, H.: Acta Oto-laryngologica 36:67, 1948.

From a statistical study the author finds the incidence of postoperative hemorrhage to be 1.9% in cases performed under local anesthesia, as compared to 2.8% for those done under general anesthesia. In a fifteen-year period he has had no pulmonary complications in those done with local anesthesia. He advocates the use of ½% novocaine without any adrenalin, and employs what he terms the "uni-locular" method of injection.

HILL.

LARYNX

Researches about Ossification and Conformation of the Thyroid Cartilage in Men.

Roncallo, Pietro.: Acta Oto-Laryngologica 36:Fasc. 2, 1948.

Examining 38 male and 19 female thyroid cartilages radiographically, the author finds several points of interest. Ossification of the thyroid cartilage begins at about 20 years of age, being slightly earlier in men than in women. The thyroid cartilages of women rarely ossify completely in advanced age as do those of many men.

Calcification and ossification are two distinct processes and can be differentiated radiologically. Several anomalies of the thyroid cartilage are presented, and detailed measurements given.

SATALOFF.

Tumor Dose in Cancer of the Larynx.

Donlan, C. P.: Radiology 50:463-467 (April) 1948.

One hundred and thirteen cases of carcinoma of the larynx treated by x-radiation during the period 1928 to 1934 inclusive, were studied with special reference to tumor dosage administered. Three years was selected as the minimum survival period. Cases were classified according to the extent of the lesion. All were squamous celled carcinoma. Tumor doses delivered by various techniques approached 5000 "r". The various factors used and those used by other authors are discussed. The survival period of each case is tabulated: one table of cord lesions and one of lesions exclusive of the cord. The improvement in technique and more careful calculation of the tumor dose of later years have had little effect on the survival rate.

JORSTAD.

BRONCHI

Progress In Bronchology.

Clerf, L. H.: J. A. M. A. 136:733-735 (Mar. 13) 1948.

About 25% of the bronchoscopies performed in the few bronchoscopic clinics that existed a quarter of a century ago were done to remove foreign bodies from the air passages, but now in many hundred of clinics established over the United States, as well as in foreign countries, less that 2% of all bronchoscopic procedures are performed for this purpose. The occurrence of foreign body accidents has not diminished, but the number of cases is overshadowed by the enormous group of bronchopulmonary diseases requiring bronchoscopic studies and treatment. Years ago the mortality rate from surgical attempts to remove foreign bodies in air passages was over 27%. Errors were common and in these cases pulmonary suppuration with chronic invalidism was the usual outcome. In our larger bronchoscopic clinics, where there are available records of many hundreds of cases of foreign bodies in the air passages, the mortality rate is less than 1% and failures are rare.

Progress has been made in the management of bronchogenic carcinoma. Cytologic studies of bronchial secretion collected through the bronchoscope has demonstrated that in at least an additional 20% to 25% of cases the carcinoma can be diagnosed positively in those in which lesions are beyond bronchoscopic vision. It also has been shown that the complete surgical removal can be carried out in a higher percentage of cases in which carcinoma occurs in bronchi be-

yond the field of bronchoscopic vision, than those in which lesions are diagnosed by bronchoscopic biopsy.

Today it is considered that bronchoscopy has relatively little place in the medical treatment of pulmonary abscess, but it still remains as a valuable diagnostic aid in cases of suspected bronchial obstruction complicated by pulmonary abscess. Bronchoscopy still has a definite place in the medical management of patients with bronchiectasis who are not suitable for surgical treatment. It also is of value in the medical preoperative and postoperative care of the surgical group.

There is an important role for the bronchologist in bronchial asthma when the tracheobronchial tree should be investigated, that is, to rule out certain conditions that simulate asthma and to remove secretions from the air passages. Mechanical aspiration of secretions should be utilized in cases of postoperative pulmonary atelectasis which do not respond to the more simple plan of therapy. Bronchoscopic catheteral aspiration also holds a definite place in the medical management of all postoperative or post-traumatic conditions in which, for various reasons, secretions can not be coughed up from the air passages.

Direct inspection of the bronchi and trachea is always of distinct value in the diagnosis of tuberculous tracheobronchitis. Bronchoscopy should be performed in the large group of cases of obscure chronic cough, hemoptysis and wheezing respiration, as well as unexplained roentgen findings and physical signs.

Bronchoscopy still offers the only method of treatment of foreign bodies lodged in the air passages. It is a valuable aid in the diagnosis of obscure bronchopulmonary signs and symptoms, and its outstanding contributions at the present time lies in this field.

BOIES.

Bronchogenic Carcinoma; the Cytological Diagnosis from Bronchial Aspirations.

Swan, Lawrence W.: Wis. Med. J. 47:1092-1094 (Nov.) 1948.

The cytological diagnosis of bronchogenic carcinoma has recently been revived by George N. Papanicolaou. In 1935 Dudgeon and Wrigley, who fixed their wet smears immediately in Schaudinn's solution, could establish a positive diagnosis in 68% of 58 proved cases of pulmonary carcinoma. In 1944 Wandall reported that 84% of the sputa of 100 cases of proved lung cancer contained

malignant cells. In 1946 Herbut and Clerf examined the bronchial aspirates of 30 proved cases and reported that 73% of the smears contained malignant cells.

Swan outlines the method of obtaining material and of its preparation for microscopic study in detail. Swan's report is based on 50 consecutive cases in which there was a clinical impression of pulmonary neoplasm. Of these 50 consecutive cases, 11 were reported positive for the presence of malignant cells. Six cases were reported doubtful and 33 were negative.

Of the 11 cases reported positive by smear, 7 were proved positive by tissue examination, in 2, tumor masses were visualized bronchoscopically and in 2 the bronchogram was definitely positive, the patient's condition being such that further studies were deemed inadvisable.

Of the six cases reported as "doubtful", the diagnosis of cancer was unconfirmed or, as in three cases, the condition was proved to be inflammatory. The other three cases all have bronchogenic carcinoma beyond reasonable doubt.

Swan concludes that (1) the cytological method is a very valuable aid in diagnosis, (2) considerable skill and experience is necessary for a reliable diagnosis of bronchial smears and sputum, (3) in his series no false positive diagnoses were made, and (4) the ease of obtaining and examining sputum makes this the method of choice in cases where more drastic procedures are deemed inadvisable, or the tumor site is inaccessible bronchoscopically.

GROVE.

ESOPHAGUS

Treatment of Esophageal Varices by Injection of a Sclerosing Solution.

Moersch, H. J.: J. A. M. A. 135:754-756 (Nov. 22) 1947.

Results of treatment of 22 cases of esophageal varices in which gastro-intestinal hemorrhages occurred are reported. The patients were treated by the injection of a sclerosing solution into the varices through the esophagoscope. Twelve of the patients had no further bleeding after treatment. All of the twelve have gone longer than three years without bleeding. Eight have gone more than four years without bleeding. Patients in whom satisfactory results were not obtained by injection of a sclerosing solution invariably were found to have varices in the cardiac end of the stomach as well as in

the esophagus, which was not true in the successfully treated patients. Roentgenologic examination is of great value in the diagnosis of esophageal varices but is not infallible. In doubtful cases esophagoscopy should be employed.

BOIES.

The Management of Lye Burns of the Esophagus.

Fisher, G. E., and Hicks, J. J.: Southern M. J. 41:591-597 (July) 1948.

The authors state that multiple varying complications will arise as a result of lye burns of the esophagus, but if these patients can be treated shortly after the accident has occurred, there are relatively few who will not have good results provided one can keep them under constant observation and regular dilatation when indicated.

In the authors' opinion, a patient who has accidentally or intentionally swallowed lye, should be given a mouthwash of a weak solution of acetic acid and advised to swallow a small amount of it, followed by a mouth wash and the swallowing of a mild bland oil. "We then insert a nasal tube into the stomach and the stomach is washed thoroughly with dilute acetic acid and water. A bland oil is then instilled through the nasal tube into the stomach. The tube is left in place for three days, so that a high caloric, high vitamin diet may be given. On the fourth day the patient is esophagoscoped to determine the extent of the damage produced in the esophageal mucosa. If only small areas of the esophagus are burned the patient is started on daily dilatations of the esophagus using a rubber mercury-filled bougie. The size of the bougie depends upon the size and age of the patient. If the patient is a child, a size 22 F. to a size 26 F. is used. If an adult, a size 40 F. is used. After ten or twelve dilatations these patients usually need no further treatment."

TAYLOR.

MISCELLANEOUS

Treatment of Migraine with Histamine.

Macy, Jr., D., and Horton, B. T.: J. A. M. A. 137:1110-1114 (July 24) 1948.

The authors report the results on 144 migrainous patients treated with histamine alone at the Mayo Clinic between the years 1937 and 1945. The migraine syndrome in 23% to 33% was unchanged after histamine therapy, irrespective of the route of administration of the drug. The syndrome of 33% to 50% of patients with typical

migraine and that of 40% to 66% with atypical migraine showed significant improvements during the period of treatment by this method. Subcutaneous administration of histamine was found to be effective in a wider variety of cases of migraine than was intravenous administration of histamine. Approximately 60% of migrainous patients, irrespective of the type of migraine, showed significant improvement during the period of treatment by this method. However, the administration of histamine both intravenously and subcutaneously was found to be the most effective method of histamine therapy in the treatment of migraine. Seventy to 85% of patients with typical migraine and 75% to 100% of patients with atypical migraine showed significant improvement in the period of treatment by this method. Although histamine was not found to be either a specific or truly curative agent in the migraine syndrome, until such an agent appears histamine will continue to have a place among the prophylactic measures of value in the clinical management of the migrainous patient.

BOIES.

Tuberculous Ulcer of the Tongue.

Wolfer, H., Hirshleifer, I., and Shapiro, R.: *J. A. M. A.* 136:249-250 (Jan. 24) 1948.

The authors report a case of tuberculous ulcer of the tongue which was successfully treated with streptomycin. They found that the action of the drug apparently was local since the patient's sputum remained positive for acid-fast bacilli, and roentgenograms of his chest during the course of treatment exhibited no changes. The ulcer responded to the parenteral administration of streptomycin but not to its local infiltration. It is suggested that this was due to the granulomatous nature of the lesion.

BOIES.

Streptomycin Sensitivity.

Rauchwiger, S. M., Erskine, F. A., and Nalls, W. L.: *J. A. M. A.* 136:614-615 (Feb. 28) 1948.

The authors report a development of sensitivity in nursing personnel through contact during administration of streptomycin to patients. For a period of 20 months, streptomycin was administered to 233 patients in the 1000 bed tuberculosis hospital at Otten, N. C. During this time sensitivity to the drug developed in six nurses. Sensitivity to streptomycin in these cases was characterized by an initial erythema followed by pruritus and a papulovesicular eruption.

The pruritus constituted a most distressing symptom. In two patients there was actual denuding of the skin over the terminal phalanges of the thumbs and index fingers of both hands. This was considered to be the result of a more frequent contact of these areas with the drug in the handling of syringes and needles. Five of the six patients showed involvement of the periorbital areas, manifested by moderate to severe edema to both lids associated with pruritis and photophobia. The conjunctivas were not involved.

Some sensitivity tests were carried out on 97 members of the nursing staff using 100 units of streptomycin intradermally. Seven persons gave definite positive reactions in 24 hours. It is strongly urged on the basis of these findings that the intradermal testing be performed as outlined in institutons where streptomycn is used at all extensively, and that prophylactic measures be put to use.

BOIES.

Diseases of the Salivary Glands.

Furstenberg, A. C.: J. A. M. A. 136:1-4 (Jan. 3) 1948.

The submaxillary and parotid glands are the two salivary glands affected by pathologic conditions which come to the attention of the otolaryngologist. The most frequent site of formation of a calculus is in Wharton's duct, after which, in order of frequency, one finds stones in the submaxillary glands, the parotid glands and Stensen's ducts.

When a gland is acutely inflamed, palliative therapy should be instituted until the acute inflamation has subsided. This is accomplished by the administration of sulfadiazine and penicillin, hot irrigations of the mouth, and external dressings, hydration, suberythemal doses of roentgen rays and gentle probing of the duct. The latter may produce sufficient dilatation of the duct to cause a spontaneous expulsion of the stone.

During the interval between acute inflammatory reaction the stones should be removed surgically. A 2% solution of procaine hydrochloride is injected about the papilla of the duct and along its course posteriorly to the region of the calculus. The papilla is then grasped and cut off. This procedure greatly facilitates the introduction of the probe into the duct. The duct is then slit open along the probe with a knife or canaliculus scissors until the stone is reached and removed with a forceps or curet. The operative wound in the floor of the mouth need not be closed by sutures. The wound

heals readily and there is a return to perfectly normal function even though the papilla of the duct has been removed and its walls have been extensively damaged by the infection and surgery.

The presence of a stone or multiple stones within the submaxillary gland associated with chronic inflammation, gives rise to the necessity of removing the entire submaxillary gland.

The author uses the same intraoral method for removing a stone in Stensen's duct. The duct mends and restores its patency in a phenomenal manner and the risk of producing a salivary fistula is of no concern. Usually when there are multiple calculi in the gland it is only necessary to reflect the skin and the subcutaneous tissue from the gland, identify the stones by palpation, incise the gland to expose them, and thus effect their removal. There is little danger of injuring the facial nerves because they are deeply situated in the tissues of the parotid gland.

The author also mentions another possible factor in parotid inflammation following general surgery, namely, the injury that may be done the parotid gland by the anesthetist who forcibly holds the jaw forward during anesthesia.

The use of sulfonamide compounds and the antibiotics has greatly altered the course and prognosis of the inflammation of the parotid gland. Seldom does this lesion eventuate in the formation of an abscess which requires surgical treatment. When incision is indicated, however, massive drainage of the gland is advocated.

Another important factor in the treatment of parotid abscess is hydration.

Mention is also made of the occasional patient who reveals an organic lesion responsible for dysfunction of the salivary glands. The patient complains of a dry mouth. This often represents some physiologic disturbance in the end organs of the nerves supplying the salivary glands. Pilocarpine therapy is frequently the most effective in these cases. Pilocarpine hydrochloride or pilocarpine nitrate is taken orally in 8 mg. doses three times a day. It should be administered before meals in order to promote salivation when it is most needed. The drug seems most effective when the person is in a mild state of acidosis. It is recommended that the alkalis be restricted in the diet and that the patient be given 3 gm. of ammonium chloride with meals three days "on" and two days "off" during the uninterrupted administration of the pilocarpine.

BOIES.

Use of Antihistamine Drugs in the Treatment for Trigeminal Neuralgia.

Horton, C. E., Brennan, A. J.: J. A. M. A. 136:870-872 (Mar. 27) 1948.

A case of trigeminal neuralgia is described in which attacks of pain were relieved by the administration of pyribenzamine and benadryl. In pain free periods, typical attacks could be provoked by the administration of histamine, but after repeated injections of histamine this drug could no longer provoke an attack of pain. The authors believe that: (1) The attacks of trigeminal neuralgia were brought about by the periodic release of some agent resembling histamine, if not histamine itself: (2) the release of the agent was provoked by exposure to some precipitating agent to which the patient was exposed seasonally; (3) the antispasmodic and sedative effect of pyribenzamine and benadryl were not important in precluding the trigeminal pain, because both atropine and phenobarbital were ineffective; therefore, pyribenzamine and benedryl exerted their therapeutic effect by antihistamine activity; and (4) the ineffectiveness of a provocative dose of histamine after a series of subcutaneous injections was given was due to a process of desensitization.

BOIES.

Oral Use of Stimulants Obtained from Inhalers.

Monroe, R. R., and Drell, H. J.: J. A. M. A. 135:909-915 (Dec. 6) 1947.

It is revealed that there is considerable habitual use of the contents of inhalers taken by mouth, the content of which are intended for vasoconstriction. The amphetamine "benzedrine" inhaler is particularly popular for this with persons who are in search of a stimulant of the nervous system. The authors made a study of the use of the inhalers in a military prison population. They found that this medication taken orally gave rise to serious disciplinary, medical and psychiatric problems. Twenty-five per cent of the inmates used amphetamine inhalers in this manner. In this group 14% had taken the amphetamine base in civilian life. The three outstanding subjective findings reported by the inmates taking the drug are: (a) "it makes the time go faster"; (b) "it makes me feel happy," and; (c) "it makes me talkative." Withdrawing the drug precipitated weakness, depression, gastro-intestinal disturbances and tremor. Injection of ascorbic acid may prove to be a successful means of treating acute amphetamine intoxication.

BOIES.

Acetylsalicylic Acid Poisoning.

Krasnoff, S. A., and Bernstein, M.: J. A. M. A. 135:712-714 (Nov. 15) 1947.

A fatal case of acetylsalicylic ("aspirin") poisoning is reported. The authors refer to eight cases of fatal acetylsalicylic acid poisoning in the American literature. The case reported was that of a 54-year-old male who ingested at least 15 to 20 five grain tablets within a three-hour period. The drug had been taken for a severe headache.

This acetylsalicylic acid had been taken between 9 p. m. and midnight and the following morning the patient was confused and incoherent of speech, complained of deafness and tinnitus in one ear, became semistuporous and lapsed into coma. He died during the following night. Postmortem study showed extensive toxic changes in the brain, kidneys, and liver.

BOIES.

Local Treatment of Carriers of Virulent Diphtheria with Penicillin.

Livey, A. J.: J. A. M. A. 136:855-857 (Aug. 27) 1948.

The authors report the use of penicillin applied locally in four carriers of virulent diphtheria. Three were treated with penicillin lozenges, 1000 units administered every two hours for six days. One was treated with a penicillin spray containing 10,000 units of penicillin per cc. A total of 2 cc. of the penicillin spray was given every two hours for six days. The authors conclude that penicillin is a powerful drug even against diphtheria when applied locally, repeatedly, and in adequate concentration.

BOIES.

Intracranial Complications of Nasal and Otitic Origin.

Embart, O.: Rev. de Otorrinolaring. 7:138-186 (Dec.) 1947, Chile.

The author reports his observations on 41 cases of intracranial complications from acute and chronic lesions of the nasal sinuses and ear.

In his introduction, a special plea is made for the care of these conditions by otolaryngologists. Their familiarity with the areas of the original focus should enable them to deal more adequately with these and the intracranial lesions at the same time.

Lateral sinus thrombophlebitis: Eight cases are analyzed. All are regarded as exacerbations of chronic otitis. The most prominent symptoms were high fluctating temperature and chills. Leucocytosis varied between ten and twenty thousand. The sedimentation rate was elevated but no exact figures are given. In three cases headache and vomiting were important manifestations of the condition. These symptoms are regarded as evidence of external pachymeningitis and extradural abscess. The fundus oculi was hyperemic in three cases. Papilledema did not occur. Surgical exposure disclosed periphlebitis in five and thrombophlebitis in three cases. All were treated by compression of both ends of the sinus with packing and open drainage without ligation.

Superior longitudinal sinus thrombophlebitis: Two cases are reported. Frontal sinusitis of five months' duration was the original focus in one case and maxillary sinusitis of one month's standing was the focus in the other. In both of these, clinical and x-ray examination failed to reveal the seriousness of the disease. The frontal sinusitis resembled tuberculous meningitis and this was the tentative diagnosis. Longitudinal sinus thrombophlebitis was established at autopsy. On examination the patient with maxillary sinusitis was in coma, with temperature of 38° C., pulse rate of 135 and white count of 28,000. The author, much influenced by his experience with the previous case, explored the frontal and maxillary sinuses and found the right antrum infected. Under penicillin therapy and drainage this patient recovered.

Otogenous meningitis: Four cases were present in this series. Three were considered as complications of otitis media with sepsis. In one the infection spread directly to the meninges by bony necrosis. Two developed purulent labyrinthitis by direct extension through the bony wall of the external semicircular canal. Following free exposure of the temporal and cerebellar dura and the lateral sinus, the meningitis and labyrinthitis both cleared under sulfa and penicillin therapy. The most prominent symptoms were intense headache, motor disturbances and irrational mental state.

Cerebral abscess: Sixteen cases are reported. Fourteen were in the homolateral temporal lobe. Thirteen of these were attributed to chronic and one to acute otitis media. Two cases of traumatic origin were located in the frontal lobes. In their order of frequency the following symptoms are given: headache and fever in all cases, increased spinal cell count in 15, abnormal mental state in 13, meningeal irritation in 12, vomiting in 11, leucocytosis in 11, and cranial nerve paralysis in 8. The local treatment consisted of drainage and

instillation of sulfa and penicillin solutions. The mortality was 45%.

Cerebellar abscess: There were 11 cases, all of which were attributed to chronic otitis media. The immediate cause was lateral sinus thrombophlebitis in five cases, labyrinthitis in three and necrosis of the cells of Trautmann's triangle in three. In order of frequency he lists the following symptoms: fever, spinal fluid changes, headache, chills, nystagmus, vertigo, papilledema, ataxia, and a "nebulous mental state."

An excellent chart of symptoms for differential diagnosis accompanies the article.

HIGBEE.

Development of Bacterial Resistance to Antibiotics.

Miller, C. P.: J. A. M. A. 135:749-751 (Nov. 22) 1947.

The author finds that penicillin resistance, when it does develop, proceeds slowly. It has not yet become a serious clinical problem because most infections are brought under control before any appreciable degree of resistance has had time to develop, and also because most patients at the present time receive doses of penicillin sufficiently in excess of the minimum required to take care of any increase in the resistance which might occur during the course of their treatment.

Streptomycin resistance, on the other hand, can develop with great rapidity. It is probably due to the production by bacteria of streptomycin resistant variants which arrive by mutation.

BOIES.

The Value of Early Diagnosis and Treatment of Lymphomas and Leukemias.

Craver, L. F.: J. A. M. A. 136:244-249 (Jan. 24) 1948.

There is at present a large hiatus in the diagnosis of cancer. In the so-called cancer prevention clinics relatively few cancers are found. In the centers for treatment of cancer the patients who come have well established malignant neoplasms. Analysis of the reasons for delay in the treatment in this latter group discloses that a large share of the responsibility for delay continues to rest on the first physician consulted.

The diagnostic hiatus which exists for cancer in general seems to be particularly noticeable in the lymphoma-leukemia field. The following reasons are stated: (1) Failure on the part of the practitioner to recognize the significance of early signs and symptoms, and (2) failure on the part of the practitioner to accept the value of early treatment. It must be admitted that no case of leukemia, acute or chronic, is curable by any method known to date, and, further, that it is doubtful that anyone is in a position to authenticate a claim to have cured any case of Hodgkin's disease, lymphosarcoma, or mycosis fungoides up to the present time. The possibility of curability of early Hodgkin's disease or lymphosarcoma depends primarily on whether these processes are of unicentric origin. The author cites case reports of early diagnosis of Hodgkin's disease and of lymphosarcoma in which removal of a single node or node mass surgically, followed by irradiation, has produced freedom from the disease for a number of years.

Any supposedly inflammatory enlarged node that does not subside within three weeks should be regarded as a danger signal demanding complete investigation. Such investigation should include competent examination of the drainage territory of the node (for example, search of the nasopharynx, tonsil and adjacent areas for possible primary lymphosarcoma in the case of enlarged node in the upper cervical region), biopsy of the primary lesion if one is found, biopsy of the node if no primary lesion is found, a careful blood cell count and, of course, a complete physical examination for enlargement of other lymph nodes, the spleen or liver. Lymphosarcoma of the tonsil is often overlooked for a long time.

Chronic lymphatic leukemia may produce, at the first manifestations, any of the findings just described as suggestive of Hodgkin's disease or lymphosarcoma. Therefore it is necessary to look at the patient as a whole in considering the differential diagnosis.

BOIES.

Penicillin in the Treatment of Diphtheria and the Diphtheria Carrier State.

Crawford, J. D.: New England J. Med. 239:220 (Aug. 5) 1948.

Based upon a study of 45 cases of acute diphtheria and 52 cases of diphtheria carriers, evidence is presented that penicillin is a valued adjunct to antitoxin; although not supplanting it in the treatment of the acute stage, nor obviating the necessity of surgery in certain types of carriers. The diphtheria bacillus grows largely upon de-

vitalized tissue produced by the action of the bacteria. The rationale for the use of penicillin is based on its effect in eliminating this detritus. These carriers with neurotic, chronically infected tonsils, which do not shrink in size with prolonged use of penicillin, will usually require surgery. Small doses, given over a long period of time, are the more effective in ending the carrier state.

HILL.

Notices

INTERNATIONAL AUDIOLOGY CONFERENCE HELD IN STOCKHOLD, SWEDEN

By the invitation of Professor Gunnar Holmgren of Stockholm, Sweden, approximately forty otolaryngologists and acoustic physicists, interested in the subject of audiology, were called to a meeting in Stockholm on September 6th and 7th, 1948, to discuss the problems of hearing as they affect the world population.

The complete proceedings will be published as a supplement to Acta Otolaryngologica. They will be available also through the Audiology Foundation, 510 Madison Avenue, New York 22, N. Y.

NOTICE

The American Board of Otolaryngology will conduct the following examinations in 1949:

May 11 to 14 in New York, New York, at the Biltmore Hotel.

October 4 to 7 in Chicago, Illinois, at the Palmer House.

NOTICE

Effective January 1st, 1949, the subscription price of the ANNALS will be increased from $7.00 to $8.00 a year. This change is being reluctantly made and was delayed as long as conditions permitted. Current costs of labor and materials make it imperative at this time.

The price in Spain, Central and South America will be $8.00 per annum payable in advance; $8.20 in Canada, and $8.80 in all other countries of the postal union.

NOTICE

The ANNALS will purchase back numbers at $1.00, each of the following which are out of print:

March, December 1940	March, December 1946
March, June 1943	September 1947
March, September 1944	March 1948

March, June, September 1945

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HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE OF THE AMERICAN MEDICAL ASSOCIATION

(List Corrected to December 1, 1948)

Acousticon Model A-100

Aurex (Semi-Portable)

Aurex Model C-B and Model C-A

Aurex Model F

Aurex Model H

Beltone Mono-Pac

Beltone Harmony Mono-Pac

Dysonic Model No. 1

Electroear Model C

Gem Hearing Aid Model V-35

Maico Type K

Maico Atomeer

Mears Aurophone Model 200

1947-Mears Aurophone Model 98

Micronic Model 101 (Magnetic Receiver)

Microtone T-3 Audiomatic

Microtone T-4 Audiomatic

Microtone T-5 Audiomatic

National Cub Model

National Standard Model

National Star Model

Otarion, Model A-1

Otarion, Model A-3

Otarion, Model A-4 J & S

Otarion, Model E-1

Otarion, Model E-1S

Otarion, Model E-2

Paravox Models VH and VL

Paravox Model XT

Paravox Model XTS

Precision Table Hearing Aid

Radioear Model 45-CM

Radioear Model 45-M-magnetic air conduction receiver

Radioear Model 45-M-magnetic bone conduction receiver

Ravox (Semi-Portable)

Silver Micronic Hearing Aid, Model 101

Solopak Hearing Aids

Sonotone Audicles Nos. 530, 531 and 533

Sonotone Model 600

Sonotone Model 700

Sonotone Model 900

Superfonic Hearing Aid

Telex Model 22

Telex Model 97

Telex Model 612

Telex Model 900

Telex Model 1020

Telex Model 1550

Trimm Vacuum Tube Model 300

Unex Model "A"

Vactuphone Model 3

Western Electric Ortho-tronic Model

Western Electric Model 63

Western Electric Model 64

Western Electric Models 65 & 66

Zenith Radionic Model A-2-A

Zenith Radionic Model A-3-A

Zenith Radionic Model B-3-A

Zenith Model 75

All of the above hearing devices employ vacuum tubes.

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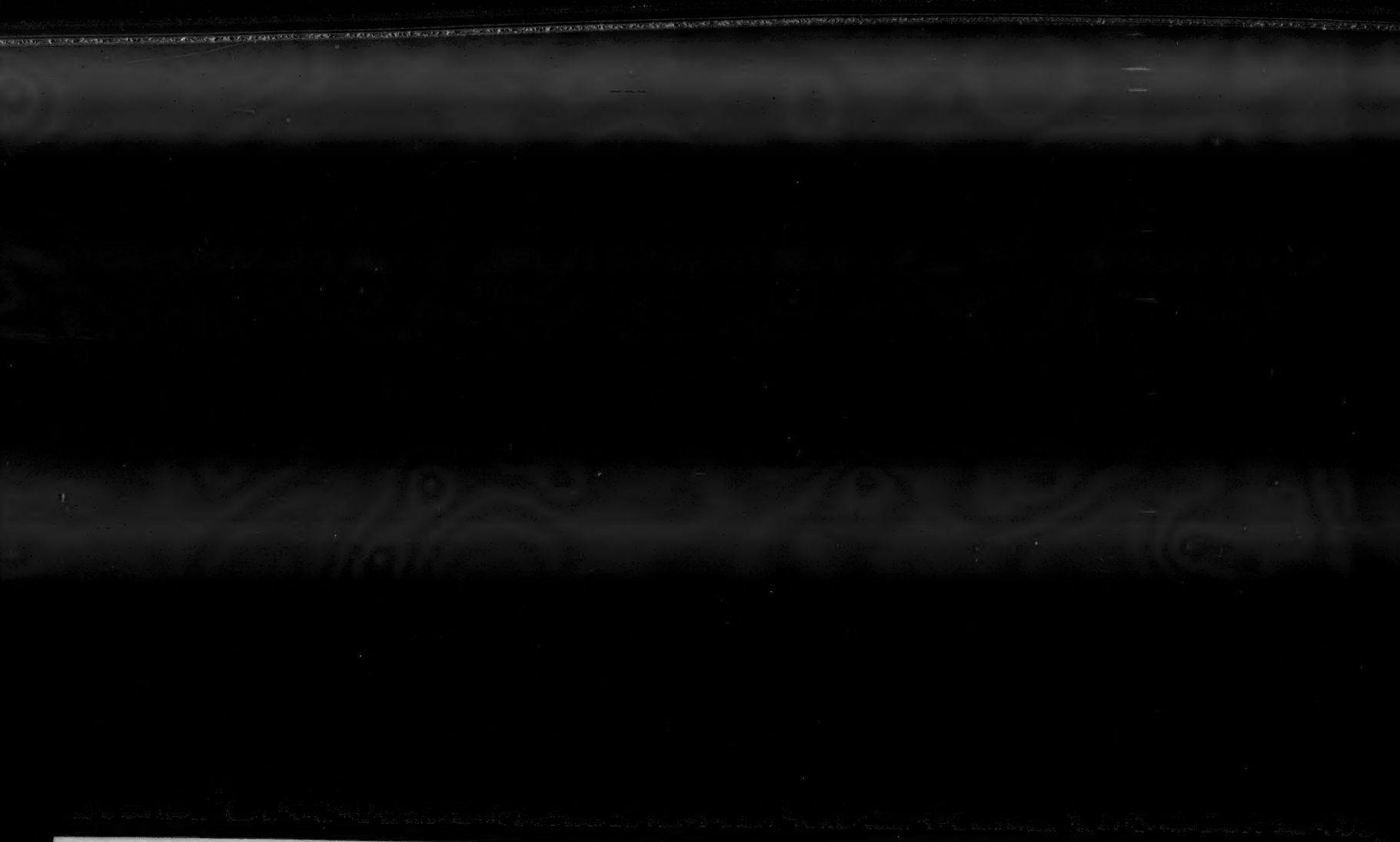
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